HISTORIC STRUCTURE REPORT

VOLUME II

COIT TOWER
SAN FRANCISCO, CALIFORNIA

Prepared For:

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April 1989

XI. EXHIBITS FOR THE STRUCTURE OF COIT TOWER

Exhibit AA

EXHIBIT AA.

SPECIFICATIONS FOR ALL WORK FOR
A MONUMENT TO BE ERECTED IN
PIONEER PARK ON TELEGRAPH HILL FOR
SAN FRANCISCO CITY AND COUNTY OF SAN FRANCISCO

ARTHUR BROWN, JR. ARCHITECT
NOVEMBER 21, 1931
REVISED MARCH 8, 1932, REVISED NOVEMBER 14, 1932

GENERAL SPECIFICATIONS FOR ALL WORK
FOR A MONUMENTAL CONCRETE TOWER TO BE
BUILT IN PIONEER PARK ON TELEGRAPH HILL
IN THE CITY AND COUNTY OF SAN FRANCISCO

~~Original Data in Book~~

Revised NOV 14 1932
& Revisions Entered

ORIGINAL DATA IN MASTER COPY
NOV 14 1932

NOV [illegible]

TOWER JAN 18 1933
(31) PIONEER PARK, Telegraph Hill. Class B tower.
Owner—Board of Park Commissioners, Golden Gate Park, S. F.
Architect—A. Brown Jr., 251 Kearny St., San Francisco.
Engineer—C. H. Snyder, 251 Kearny St., San Francisco.
Contractor—Young & Horstmeyer, 461 Market St., S. F. $100,000

00 calendar days from date of issue of permit

Dedicated Oct 8-1933

Location of Specs

1 Office- Mr Hatch (Signed)
2 Office- Mr Baur
3 Park Commission (Signed)
4 Young & Horstmeyer (Signed)
5 Young & Horstmeyer
6 Young & Horstmeyer
7 Young & Horstmeyer
8 Young & Horstmeyer
9 Permit to Job
10 Permit recorded.

COPY NO. 1

SPECIFICATIONS FOR ALL WORK

FOR A

MONUMENT

TO BE ERECTED IN PIONEER PARK ON TELEGRAPH HILL

IN

SAN FRANCISCO

CITY AND COUNTY OF SAN FRANCISCO

OWNER

ARTHUR BROWN, JR.
ARCHITECT
251 KEARNY STREET
SAN FRANCISCO, CALIFORNIA

Dated November 21, 193
Revised March 8, 1932
" NOV 14 1932

SCHEDULE OF SECTIONS

1. GENERAL CONDITIONS AND DATA
2. EXCAVATING AND GRADING
3. CONCRETE
4. CAST STONE
5. CEMENT WORK
6. CARPENTER WORK
7. MEMBRANE WATERPROOFING
8. SHEET METAL
9. ROOF TILING
~~10. VAULT LIGHTS~~
11. MISCELLANEOUS IRON
12. STEEL SASH
13. ORNAMENT TILE
14. GLASS
15. PAINTING
16. PLUMBING
~~17. HEATING~~
18. ELECTRICAL
~~19. KITCHEN EQUIPMENT~~
20. HARDWARE
21. ELEVATOR
22. BRICK
23. ALTERNATES

Addenda Sheet
Dec. 27th, 1932

Addenda No. 2 - to the General Specifications for a Monument on Telegraph Hill - Pioneer Park - San Francisco, California

GENERAL NOTE: This Addenda #2 is an integral part of the General Specifications and supersedes all other clauses or requirements of those Specfications or of any Addenda thereto of a date previous to this Addenda where they conflict with this Addenda.

Concurrent with this Addenda #2 are revisions in the accompanying drawings. All drawings so revised are marked "REVISED NOV. 12th, 1932". Any blue print or tracing or drawing not showing that mark shall not be used for contractual document, working drawings or for purposes of construction.

This Addenda #2 is an addition to the GENERAL CONDITIONS AND DATA, Section #1, and shall be added on Page 1-6 thereof immediately preceding the paragraph "Subdivision of Work Under Headings" and shall read as follows.

RATE OF WAGE: The following schedule covering the minimum rate of wages that shall be paid to mechanics, laborers or others employed on this work shall apply without reservation to this contract. It is expressly understood and agreed that this rate of wages shall be paid unconditionally in full not less often than once a week and in lawful money of the United States, to the full amount accrued to each individual at the time of payment and without subsequent deduction or rebate on any amount.

Carpenters	$ 7.20
Electricians	9.00
Elev. Constructors (helper - 7.28)	10.40
Hoisting Engineer	9.00
Housesmiths (reinf.)	9.00
Painters	9.00
Plasterers (helper - 7.50 - hodcarrier)	11.00
Plumber	10.00
Sheet Metal	9.00
Laborers	5.50
Cement Finishers	9.00
Tile (helper - 6.00)	10.00

Addenda Sheet
Nov 14th 1932

Addenda No 1 to the General Specifications for a Monument on

Telegraph Hill- Pioneer Park- San Francisco California

GENERAL NOTE:- This Addnda No 1 is an integral part of the General Specifications and supercedes all other clauses or requirements where they conflict with these Addnda. Any work or materials provided for herein shall be performed and/or finished as required for similar work in the Original General Specifications.

Concurrent with this Addanda No 1 are revisions in the accompany ing drawings. All drawings so revised are marked REVISED NOV 12th-1932. Any blueprint or tracing or drawing not showing that mark shall not be used for contractual document, working drawing or for purposes of construction.

The original arrangement of the first floor spaces were called "Restaurant" for the outer ring and "Kitchen, store room Boiler room" for the inner part. These names have now been changed to "Public Spaces" for the outer section and " Inner Space" for the inner section. They will be so read in main body of the Specifications.

CHANGES IN THE DRAWINGS:- Changes in the drawings are matters of record to be obtained from the drawings; but for the convenience of the Contract or the following memorandum is inserted herein:- It is not inclusive of all changes, the documents themselves are the final source of information.

Sheet No 1:- Entrance changed. Spouth terrace reduced in size to a rim around the building and is to be included as ~~part of the contract price and not as~~ an alternate. Planting boxes and wing walls are intro duced on the front part of the terrace. This front part, formerly an Alternative, is now a part of the contract.

Sheet No 2:- Entrance changed. Arches cut out and a furred ceiling substituted. Vestibule screens out. Kitchen fittings and vents out. Boiler room and heating plant out. Door between vestibule and Janitors Closet out. Skylight over vestibule out.

Sheet No 3:- Base of tower cut down to bare octagon. Janitors quarters moved to the fornt and a kitchenettee introduced. Vault lights cut out. Corner copper covered decks at base of tower out. Flutes in shaft cut down from 32 to 24. Small pilons at tops of buttresses cut off. Gas supply for "flare" at top added. Plumbing arrangement changed In Plan GG cast stone balustraded introduced in place of plain wall. Plans JJ & KK changed- See Sheet No 9. Sizes of windows in Towers reduced and corner windows in base cut out. Three cast stone ornaments introduced over front door.

CHANGES IN THE SPECIFICATIONS:-

Schedule of Drawings:- Delete Sheets 4 & 6 in Architectural set.

Sect 1- Pg 1- Geml Data:- In third paragraph, third line down. Change Restaurant to "space". Delete third sentence commencing with "This restaurant" etc. In 7th & 6th lines up delete "tea Room "& "restaurant".

Sect 1- Pg 2. Work Included:- Delete Sections 10/17 & 19. All parts of these are entirely removed from the Specifications or requirements. There will be no Vault lights, No heating and No kitchen equipment.

Sect 3- Pg 13. Interior Work-Special Parts:- Change "restaurant" to "Public Spaces" and "kitchen"to"Inner space". in first and second pars.

Sect 3- Pg 14. Exterior Work:- In first section-second line change "restaurant"to "first floor" and delete "the Arches" at the beginning of the line.

Sect 3-Pg 15. In third line down change "3'6" to 4'6" and in fift line down change 3" to 5".

Sect 3- Pg 23. Type B:- Delete "corner" in third line; and change "of Plan DD" to "over vestibule". In fifth line change "These four" to "this" and make "decks" singular. There is now only one very small deck to be covered with copper over the front door part.

Type D: Change "kitchen" to "inner area" and add "first floor" at end of line.

Sect 4- Pg 1- In third line down, delete "grilles" and change "Are" to"is". The heating grilles have been cut out. There are only two small cast stone grilles left-over the two toilet windows.

Sect 4- Pg1- Models:- In secton line change "this " to "the". final sentence. "Allow $400.00 for modeling and plaster casts."

Sect 4-Pg 1- Manufacture:- In first line, change "This" to "the" and delete "grilles". Same in eighth and ninth lines down. Same in first line of next paragraph.

Sect 4-Pg 2 Installation:- In first line, change "these" to"the" change "grilles" to "cast stone".

Sect 4- Pg 2. Add a section"AMOUNT:- Items to be cast in stone shal be one placque, two fasces, two grilles-toilet windows, Balusters in Plan G G."

Sect 5- Add a paragraph at end of section-" "HUNG CEILING:- The ceiling of the outer entrance vestibule *and Elevator Lobby* shall be hung. All metal shall be galvanized. 1-1/2" galv. channels set 24" on centers shall be hung to th concrete with No 10 galv. wire set 24" on centers. 3/4" galvanized channels shall be tied to the runners 12" on centeres with No 18 galv wire. This mat shall be lathed with No 18 gage galv. wire cloth, two meshes to the inch. Cloth shall be plasterd with three coat cement plaster finished to match walls. *(all hung ceilings were omitted.*

Sect 6-Pg 1. ~~RoughxCarpenterxWorkxxxx~~ Material: In third par. delete "Vestibule Screen".

Sect 6- Pg 2. Copper Cleating:- In first and second lines, from "The" to "Plan CC" change to read. "The small roof over the Vestibule" etc

Sect 6- Pg 4. Grilles & Grille doors:- In first sentence delete Q "two" to "restaurant" leaving " There are". In Third line insert "and" after "Lobby". In 4th & 5th Lines delete "And" to "kichen" inclusive.

Sect 15- Pg 6. Where restaurant occurs on this page change it to "public Spaces". Where "Kitchen" occurs change it to "Innerspace". Omit reference to furnace room, storage, etc.

Sect 16- Pgs 1-2&3:- These pages are all right as they are. The balance of the Plumbing section No 16 has been re-written.

Section No 17-Heating:- Omit this section entirely:

Section 18-Pg 2- Service:- In eighth line down after "Trumbull" insert "Square D".

In ninth line delete "wall" and insert "main switch board."

Section 18-Pg 2- Switchboard:- In third line down, after "manufacture" insert "or Diamond Electric- Type PK-"Saflox".

Section 18- Pg 2- Panel Boards & Cabinets:- In first line after N.T.P" insert " or Diamond Electric".

Section 18-Pg 3- Rewrite entire page to provide for changes in panel boards.

Section 18-Pg 5- Fan Control:- Omit this item.
Propeller Fan Connection: Omit this item.
Lighting Fixtures:- In third line change amount allowed for lighting fixtures, other than those directly specified, from Six hundred dollars to Four Hundred ($400.00) dollars)

Section 18- Pgs 6/7/8/9 Have been rewritten.

Section 19- Omit this section entirely.

Section 20- Pg 3- Hardware Schedule- Page re-written.

Sect 20 -Pg 4- Hardware Schedule: Page re-written.

Sect. 20-Pg 5. Hardware Schedule: Change "Grilles" to "Grilles on Doors" and change quantities from 72 pair of butts and 72 catches to eight pair of butts and eight catches.

Section 22- Pg 1- Structural Tile:- Omit this paragraph entirely. There is no partition walls. Use 4" concrte walls instead.

Section 22- Pg 2- Structural Partition Tile:- Omit this paragraph.

Section 22-Pg 3- Laying Partition Tile:- Omit this paragraph.

Section 23-Pg 1- Alternates:-

Alternate No 1:- Modify extent of terrace to agree with revised drawings. Give revised price for this.
Alternates Nos 2 & 3:- Disregard these Alternates.

Alternate No 4:- Modify to suit new drawings, including earth boxes, wing walls, etc. Give revised price for this.

Alternate No 5:- Drinking Fountain & connections. Give alternate price for this, complete.

SCHEDULE OF DRAWINGS

ACCOMPANYING THE SPECIFICATIONS FOR THE MONUMENT

ARCHITECTURAL:	Revised March 8, 1932
Sheet No.1:	Plot Plan and Alternates
2:	1/8" Scale Plans
3:	1/8" Scale Elevations & Sections
3-A:	1/8" Scale Sections
~~4:~~	~~Entrance Details~~
5:	First Floor - Exterior Details
~~6:~~	~~Miscellaneous Exterior & Interior Details~~
7:	Belvedere Details
8:	Details - 1st Floor Elev. Lobby & Roof Stair
9:	Roof Details
STRUCTURAL:	Original of November 21, 1931
Sheet S-1	Foundation & Sections
~~S-2~~	~~1st & 2nd Floor Plans~~
~~S-3~~	~~Wall & Slab Details~~
~~S-5~~	~~Wall Elevations~~
STRUCTURAL: -	A series - Added March 8, 1932 (Supplementing & Revising the originals of 11/21/31)
Sheet S-1-A:	Foundations & Sections
S-2-A:	1st & 2nd Floor Plans
S-3-A:	Wall & Slab Details
S-4-A:	Tower Plans
S-5-A:	Wall Elevations
MECHANICAL:	Revised March 8, 1932
Sheet M-1:	Plumbing Heating & Electric
M-2:	Plot Plan & Details
M-3:	Wiring Details

cure and pay for all licenses, fees, permits, etc., that may be required to commence, carry on and complete the work. He shall set all lights and enclosures as may be required. He shall be responsible for any and all loss, accident, neglect or damage which may be the result of or caused by his building operations or the operations of any of his sub-contractors, and for which the Owner might otherwise be held liable. He shall place and maintain during the entire life of the contract, Public Liability and Compensation Policies insuring all risks on the work, and shall require the same action on the part of all of his sub-contractors. The Contractor shall be solely responsible for any and all work or actions done by any of his sub-contractors; and all orders or instructions from the Architect shall go through him to them. All materials, fittings, etc., shall be new and the best market quality unless otherwise specified. All labor shall be competent and skilled for the work to be accomplished.

He shall measure and lay out the work and shall be responsible for its accuracy. He shall give his personal attention to the work and shall keep a responsible foreman thereon during all working hours who shall be authorized to receive and execute orders from the Architect.

At the completion of the work and before the Acceptance Certificate will be issued by the Architect, the contractor shall remove any and all tools, debris, materials, appliances, etc., and all rubbish, debris packing, etc. of any kind from the building premises, adjacent premises, sidewalk and street. He shall go over all work and put the same in first class order and condition and in strict accordance with the terms of the Contract. He shall repair or replace any broken, stained or damaged parts of the work, whether so damaged or stained by his building operations or by others not connected with the work. He shall clean and sweep the building thoroughly. He shall clean all glass free from paint or other stain and shall wash and polish all glass. When these things are done to the satisfaction of the Architect, the Acceptance Certificate will be issued.

Thirty five days after the date of the recording of the notice of

acceptance, the Contractor shall again go over all of the work, making all necessary repairs, corrections and adjustments, and putting all of the work in good order and condition and satisfactory to the Architect. After which overhauling, the thirty five day or final payment certificate shall be considered as due, and not until then.

The Contractor's Relations with the Architect, Etc: The Architect shall have full supervision of the work. No part of the work shall be considered as passed or accepted until it has been specifically examined and approved by him and by the Park Commission of the City and County of San Francisco acting as Trustees. These specifications and the drawings accompanying them are one document; any work mentioned in the one and not shown in the other, or vice versa, shall be furnished and performed as though it were mentioned or shown in both. Any deviations from the specifications or the drawings without the written consent of the Architect shall be at the sole risk of the contractor and subject to rejection, immediate removal and prompt replacement at the order of the Architect. The decision of the Architect as to the interpretation of any letter, figure or character on the drawings or as to any letter, character or wording of the specifications shall be final and binding on the contractor. Scaled details shall be followed in preference to smaller drawings. Figured dimensions shall be followed in preference to scaled measurements. Work not dimensioned shall be executed in accordance with the directions of the Architect.

All work shall be done in accordance with the requirements of these specifications, with the drawings accompanying them and with the details that will be issued by the Architect to further illustrate and explain the same. Any work not done in compliance with these documents shall be removed if so ordered by the Architect and replaced with the proper work and at the expense of the Contractor. Datum point for all levels and lines shall be as shown.

<u>The Contractor's Relations with the Owner, Etc:</u> The Contractor shall, before commencing any work, file two bonds with the Architect. These shall be issued by a Surety Company and shall be satisfactory to the Architect, and shall be maintained during the entire life of the Contract and at the expense of the Contractor. One bond shall be in the amount of fifty (50%) per cent of the contract price and shall guarantee the faithful performance of the contract. The second bond shall be in the amount of fifty (50%) per cent of the contract price and shall guarantee the payment in full of all claims that may arise under this contract

The Contractor shall place, when so required by the Architect, a fire insurance policy covering all fire risks, storm and element risks on the work. This policy shall meet with the approval of the Architect and shall be filed with him. This policy shall be maintained during the entire life of the contract and at the expense of the contractor.

The Contractor shall place and maintain during the entire life of the contract and at his expense, a Public Liability Insurance covering all risks on the work.

The Owner reserves the right to reject any and all bids or to accept any bid. The Owner reserves the right to perform work on the building or to have the same performed by another contractor. This contract will be deemed completed when all of the work contracted for shall be duly and properly performed and all of the acts on the part of the Contractor as set forth above as being necessary for completion have been completely and satisfactorily performed.

<u>Arbitration:</u> In the event of any question arising between the Owner and the Contractor that cannot be settled by mutual agreement it shall be submitted to arbitration. The Owner shall select one arbitrator, the Contractor a second arbitrator and the two arbitrators shall select a third. The decision of two of the three arbitrators shall be final and binding on all parties to the dispute. This selection and establishment of the Board

of Arbitration and their decision shall be made without delay. Pending the decision the work shall be continued without delay.

The costs of the arbitration shall be determined, assessed and allocated by the Arbitrators.

SUBDIVISION OF WORK UNDER HEADINGS:

For convenience in letting contracts the work is divided under separate headings. However the Contractor in letting the contracts for the subdivisions of the work may take work out of each separate heading or may add work to each separate heading if he so desire, provided however that he make written agreements signed by the parties affected by such changes in the allotment of the work and clearly setting forth such changes. In lieu of such agreements it is to be understood that the subdivisions under headings made in this specification are binding on the Contractor and on the various sub-contractors.

THE CONTRACTOR'S RESPONSIBILITY FOR WORK:

It is understood that the Contractor is responsible for all work necessary to complete the building whether called for under the separate headings or not, and that all requirements of the State and Local authorities shall be complied with by him. Where such requirements are included under the work called for under the separate headings they shall be furnished and provided for under those headings unless otherwise provided for by the Contractor; but if such work or such requirements are not provided for under the separate headings, then they shall be provided for by the Contractor and shall be included in his estimate of cost and his guarantee cost.

GENERAL MANAGEMENT:

The Contractor shall have the general management of the work. In case of damage to the work of any sub-contractor he shall, where possib[le] place the responsibility. He shall adjust claims, and assist the various sub-contractors in settling any disputes that may arise among them.

LAYING OUT THE WORK:

The Contractor shall measure and lay out the work and shall be responsible for its accuracy. Each sub-contractor is required to lay out and be responsible for his own work, but the Contractor shall employ a competent surveyor to place the building, to establish the building lines and levels and to check the work of concrete foundations, walls and columns and to be sure that they are in the correct position and at the correct levels. He shall assist the sub-contractors in establishing their principal lines and levels.

CLEANING:

The Contractor shall see that all sub-contractors do their own cleaning up, removing their debris and rubbish from the premises. He may arrange to do all cleaning apportioning the cost among the sub-contractors in relation to the amount of debris left by them. In any case he shall do general cleaning from time to time as necessary to keep the premises clean and in an orderly condition.

At the completion of the work, the Contractor shall remove all tools, appliances, materials, debris or rubbish from the building, premises and streets and shall sweep and clean the building thoroughly. He shall clean all glass and mirrors, absolutely removing all paint, stains, mortar, etc. without scratching or injuring the glass, and shall leave the work bright, clean and polished. After defective glass work is removed and replaced, the replaced work shall be cleaned as specified. He shall cause all sub-contractors to remove all stains, spots and other disfigurements caused by their work on all floors, walls and other places. He shall go over all of the work after the sub-contractors are through with their work and cleaning and shall leave the same unspotted, unstained and in perfect order and condition.

REPAIRS:

At the completion of the building, the Contractor shall cause all

sub-contractors to go over their individual work and repair all damage to their work by whomsoever caused and make good or replace any faulty defective work. He shall go over all work after the sub-contractors are done and shall put the entire building and all of its appurtenances in perfect order and repair.

CUTTING;

Where cutting becomes necessary, the Architect shall first be notified. His direction as to the cutting shall be followed explicitly.

The Contractor and each sub-contractor shall do any necessary cutting or repairs in his or their own work as may be required by the work of other sub-contractors. Where cutting is required into the work of other sub-contractors it shall be done by the sub-contractor whose work is to be cut or disturbed unless written permission is given by the Architect allowing the cutting to be done by others.

Where cutting is necessitated by the neglect on the part of any sub-contractor to make provisions for the work of other sub-contractors or is due to failure to notify or co-operate with other sub-contractors the expense of the cutting shall be borne by the sub-contractor at fault. On the other hand, if a sub-contractor neglect to provide for his work after being notified by another sub-contractor or if he neglect to give another sub-contractor proper notice or information as to the location of his own work or the necessities for making provisions therefore, then the expense of any cutting into another sub-contractors work caused by such negligence shall be borne by the negligent sub-contractor.

All work cut into or disturbed shall be made good and repaired at the expense of the party responsible as specified above.

LICENSES, PERMITS, AND FEES;

The Contractor shall procure and pay for all licenses, permits, fees, etc. required to commence, carry on and complete the work.

WATER:

Each sub-contractor shall pay for the water used by him. The Contractor shall pay for all water apportioning to each sub-contractor the amount chargeable to him.

LIGHT AND POWER:

The Contractor shall install and pay for all temporary lighting and power unless otherwise provided for under the separate headings. He shall furnish the lamps for temporary lighting of a general nature, or shall arrange for each sub-contractor to furnish his own lamps where the sub-contractors in question require special lighting for their individual work

FIELD TELEPHONE:

The Contractor shall have installed and maintained a telephone for his own use and the use of sub-contractors and inspectors and Architect's representative. This telephone may be a pay phone or the Contractor may arrange with sub-contractors on a pro-rata charge proportioned to the use of the telephone.

OFFICES, SHEDS, BARRICADES:

The Contractor shall furnish and erect and maintain an office for the use of himself and the Architect's Superintendent, a properly locked tool house, a shed for toilets, and shall erect and maintain any necessary fences, barricades, or covered passaged for the protection of the public.

The Contractor shall furnish and maintain the necessary railings around openings in floors, around stair wells and etc. He shall provide all requirements for the safety and protection of workmen or others employed on the building or who have business in the building.

FIELD TOILET:

The Contractor shall provide a proper and adequate field toilet and shall maintain the same in a good and sanitary condition until the permanent fixtures can be used.

TEMPORARY STAIRS AND LADDERS:

as required and strong ladders to give easy access to all parts of the building. He shall furnish and set plank treads on the stairs as soon as they are in place maintaining same until the permanent treads are finished

LOCATION OF PARTITIONS & OPENINGS:

The Contractor shall lay out partitions and openings in partitions and shall check the placing of openings in walls.

This laying out and checking of lines and work will not relieve sub-contractors of the responsibility for laying out their own work, but the Contractor is responsible for the correctness of all work under the contract whether under sub-contract or done directly by him.

PROTECTION:

The Contractor shall protect adjacent property from all injury, trespass or damage of any kind and any damage or other injury caused by his work or any building operations to such property shall be repaired and restored to its original condition.

SURVEYS, ETC:

The Owner will furnish a survey of the property. The Contractor shall have the layout of the building and all main building and wall lines checked and verified by a licensed surveyor and at his expense.

PROPRIETARY ITEMS: Where any material, manufacture, process or similar item or work is limited by the name of the manufacturer or patentee of the item or work, such limitation shall be considered as an identification and/or description of the item and is not intended to exclude other and similar items or work manufactured or produced by others not specifically named. The Contractor shall have the privilege of submitting a list of desired substitutions within ten days after the execution of the Contract. This list shall itemize specifically what substitutions the Contractor wishes to make and the amount of the deduction or addition to the contract price of each proposed item of substitution. This list will be considered by the Architect and the Park Commission and their decision on each item

will be returned to the Contractor within fifteen days after the receipt of the list and the contract price adjusted accordingly. It is a assumed that, unless there is a variation in price between the item specified and the item proposed to be substituted, there is no valid reason for substitution; and decisions on proposed substitutions will be based largely on the price factor. The decision of the Architect and the Trustees will be final and no further proposals for substitutions will be allowed.

In general the phrase "or equal" or "or equal and approved" will appear herein after each proprietary name. In all such cases it is understood that such items shall be included in the category of possible substitutions as above mentioned.

CONDUCT OF THE WORK:

The Contractor shall arrange with the Architect as to the conduct of the work, placement of material, work sheds, etc. all of which shall be done as directed by the Architect. The main drive shall be kept entirely clear and shall not be used for any purpose other than as a thoroughfare. Not more than forty (40%) per cent of the area of the circle at the top of the drive may be used for unloading material, work houses, bunkers, etc. and such part shall be fenced off and gated from the area reserved for the public as directed by the Architect. Material teams must not obstruct public traffic. It will probably be necessary to extend the drive temporarily to the upper level. In which case the natural lie of the land shall be disturbed as little as possible and shall be restored to its original condition when the use of the temporary road ceases.

PREVALENCE OF THE SPECIFICATIONS:

In the event of a conflict between the drawings and the specifications that cannot be decided by the contex of the data or the necessities of the case, the specifications shall prevale over the drawings.

EXCAVATING & GRADING

WORK INCLUDED:

This Contractor shall furnish all labor, materials, tools, appliances and equipment required and necessary for performing and finishing in a workmanlike manner all Excavating & Grading for all foundation work, concrete step approaches, preparations for the laying of concrete work, concrete of the ground floor, etc., all backfilling around foundations, underground floor and around entrance steps and all other excavating, backfilling, and grading work as may be shown, indicated or noted on the drawings, specified herein or required to complete the work.

Excavating and backfilling for plumbing, heating and electric work will be done by the sub-contractors for these divisions of the work.

CLEARING THE SITE:

All construction, concealed pipes or wires, old foundation walls, concrete steps and other material of any kind now on the site or in the parts adjoining the site that in any way interfere with the proposed structure shall be cleared off and entirely removed.

Any shrubbery, trees, etc., that may be selected by the Architect as to remain on the site in the parts not occupied by the structure, shall be preserved and protected from injury by the contractor.

If any piping, soil piping, etc., on the site is uncovered in the course of the excavating, the Architect will direct whether or not it shall be disconnected and capped or otherwise taken care of by boxing, etc., and its use continued.

EXCAVATING:

It is the intention of these specifications and the drawings accompanying them that all foundation work shall rest on solid, undisturbed virgin rock. The excavations shall go down to at least the depth shown on the drawings, which is minimum, and as much further as may be required to reach the solid rock. If soft spots of limited area are found under foundations they shall be excavated down to solid rock or

spanned with a designed concrete beam as the Architect may decide. In the case of the four piers under the tower proper, the excavations must go down to solid rock satisfactory to the Architect.

Excavating for plumbing and electrical work may be done by the sub contractors for those sections, but all such work shall be under the control and at the responsibility of the Contractor. Such excavating work shall be done at safe and sufficient distance from the foundations, especially those of the Tower, to satisfy the Architect as to the safety of the adjacent foundations.

Where footings enter solid rock, the cut shall be to the neat dimensions of the footings and the form work shall be omitted. All such conditions of footing work shall be approved by the Architect.

Footings shall be finished at an approximate level and steppings shall be approximately vertical. The bottoms of footings shall be clean and free from any loose rock, dirt, debris, etc.

Excavate and grade for all cement slabs resting on earth. Where such slabs do not rest on sound earth or rock, then the voids shall be filled with small rock and earth thoroughly rolled and tamped and brought to the required level.

ROCK DRILLING FOR ANCHORAGE:

Certain holes shall be drilled in the rock below the bottoms of the footings for extra anchorage for the tower piers. The location, size and extent of these are shown on the drawings. These holes shall be made by drilling process and shall not be blasted.

BLASTING: If drilling and blasting becomes necessary in order to excavate to the depths indicated on the drawings, it shall be done by experienced men and in strict accordance with local ordinances. This Contractor shall furnish an ample supply of mats and logs and shall see that all blasts are properly covered before firing. The utmost care and best judgment shall be used in blasting to the end that the rock ... the bottom of foundation shall be undisturbed, and that

excessive vibration or damage to other property will not result.

GRADING:

A ll excavated materials lying above finished grade levels shown o on the drawings shall be spread about the premises as directed by the Architect, so that none of this material remains above finished grade levels. Should there not be a sufficiency of suitable excavated material to complete the required grading then fresh material shall be brought in from the outside.

Excavated rock shall not be used for backfilling except in combination with earth or sand as directed by the Architect and in no case shall such rock backfilling occur nearer than 9" to any horizontal or vertical surface of the structure.

BACKFILLING:

After foundations are poured, stripped and approved, backfilling shall be done using excavated material so far as it is suitable and bringing in fresh clean earth or sand for completing the top work.

WASTAGE:

Any excavated material not suitable or required for backfilling and grading shall be removed from the premises.

CARE OF ADJACENT CONSTRUCTION

Construction now in, such as the cement steps, terraces, driveways, etc., shall be carefully protected from injury during and by cause of the process of construction. Any construction so injured shall be replaced and restored as required.

CONCRETE WORK

WORK INCLUDED:

This Contractor shall furnish all labor, materials, tools, appliances and equipment required and necessary for performing and finishing in a complete, workmanlike and satisfactory manner all concrete work as is shown, indicated or noted on the accompanying drawings and/or specified herein.

WORKMANSHIP:

In general, the workmanship shall be equal to the best practice in modern construction. All work shall be done in a thorough manner and shall be first class in all respects. The Contractor shall take the greatest possible care to make a uniform dense concrete, true to elevations and lines as are shown on the drawings.

CONTRACTOR'S EQUIPMENT:

This Contractor shall furnish a modern, up-to-date plant for handling and erecting the materials, including mixers, water control equipment, hoisting plant, bunkers, conveyances, tools and other equipment as required for the proper and speedy construction of the work. The Architect may order removed any equipment which in his opinion is insufficient, defective or dangerous or in any way unsuitable for the proper prosecution of the work.

EXCAVATION & BACKFILL:

Excavations: The building and site will be excavated to general levels as specified under "Excavation & Grading" specifications.

A dditional Shoring, Etc: This Contractor shall furnish all labor, materials, tools and equipment required to do all bulkheading, shoring, excavating, grading and backfilling not specified in these specifications, but necessary to construct properly all concrete work shown on the drawings and/or specified herein.

Backfill: Backfill shall be sand or earth. All backfilling must

be done in layers of twelve (12) inches or less. Each layer must be wetted and thoroughly tamped compactly into place before placing the succeeding layers. This Contractor shall do all backfilling necessary to support concrete structures shown resting on the ground such as floor slabs, steps and similar construction.

MATERIALS; GENERAL:

Materials in general to be used in this work shall be the very best of their respective class or kind. The material will be subjected to a rigid examination and if found defective, undersized, or otherwise unsuitable, or not as specified, will be condemned and the Contractor shall promptly remove from the premises all such condemned materials whether they are incorporated in the building or not.

Materials shall be stored so as to cause no obstruction to other work, or to the public, nor shall any portion of the structure be overloaded. Materials shall be properly protected from the weather or other damage.

CONCRETE:

Cement: All cement shall be of Portland grade and shall be of a standard brand, to be approved by the Architect and which conforms to the standard specifications, current edition, of the American Society for Testing Materials and shall have been in local use for at least three years. All cement shall be shipped in good sacks containing ninety-four (94) pounds or one cubic foot of cement and must be stored in a properly protected, ventilated and watertight place. Any lumpy or caked cement must be immediately removed from the job.

Concrete Aggregates:

a. Fine Aggregate or Sand shall consist of clean, hard, strong durable, uncoated grains and be free from injurious amounts of dust, lumps, soft or flaky particles, shale, alkali, oil, organic matter, loam or other deleterious substances. It shall not contain more than

three (3) per cent of mica by volume.

Its mesh composition shall be such that 100% shall pass a 1/4" screen; not more than 80% nor less than 60% shall pass a 10 mesh screen, not more than 30% nor less than 15% shall pass a 50 mesh screen and not more than 15% shall pass an 80 mesh screen.

The fine aggregate shall be of such a quality that mortar briquettes or cylinders, composed of one (1) part of cement and three (3) parts of fine aggregate by weight will show a tensile or compressive strength at ages of seven (7) and twenty-eight (28) days not less than that of one (1) to three (3) standard Ottawa sand mortar of the same consistency made with the same cement. If the strength developed by the fine aggregate in the one to three mortar is less than 70% of the strength of the Ottawa sand mortar, it shall be rejected; but if the strength developed is greater than 70% and less than 100% of the strength of the Ottawa sand mortar, the Architect shall have the option of allowing its use provided the Contractor uses such proportions of cement to fine and coarse aggregates as will produce a concrete of the required strength and quality. The additional cement to be used shall be based on tests made under the direction and subject to the approval of the Architect.

The use of Beach or Bank sand, fine river sand, or any other uniformly graded sand will not be permitted.

b. Coarse Aggregate shall consist of clean, hard, durable, uncoated particles of close grained, crushed igneous rock, gravel or crushed gravel, and shall be free from injurious amounts of soft, friable, thin, elongated or laminated particles, loam, organic or other deleterious matter.

It shall be well graded from a minimum size that will be retained on a 1/4" screen up to the maximum specified size and shall contain an appreciable amount of well graded material passing a 1/2" screen.

The maximum specified size shall be such that all will pass a one and one-half (1-1/2) inch screen and not more than ten (10) per cent will be retained on the one and one-quarter (1-1/4) inch screen.

The coarse aggregate shall be divided into two gradings and shall be stored separately on the job. The aggregate passing the three-quarter (3/4) inch screen to be one grading and the aggregate retained on the three-quarter (3/4) inch screen to be the other.

c. The water used in mixing concrete must be fresh, clean, and free from earth, dirt, sewage, acid alkali, organic matter or other impurities liable to be injurious to concrete.

d. An admixture of one and one-half pounds (1-1/2) of diatomaceous earth shall be added to the concrete mix for each sack or cubic foot of cement used.

Where "densified concrete" is specified the proportion shall be three pounds of diatomaceous earth to each sack of cement and a heaped shovelful of cement shall be added to compensate for the added bulk of the earth.

Where "super-densified" is specified the proportion shall be five pounds of diatomaceous earth to each sack of cement and a shovel and one-half of cement shall be added to compensate for extra bulk of earth

Calatom, Celite or Diasil brands of diatomaceous earth will be approved.

Proportions; The exact proportions of the cement, fine aggregate and coarse aggregate to be used in the concrete shall be determined, for the materials to be used, by tests made under the direction and subject to the approval of the Architect. The testing laboratory shall be as selected by the Architect. Cost of these tests, determination and control of the concrete mix shall be paid for by the Contractor. The grading and quality of the fine and coarse aggregates shall be uniformly maintained throughout the work, as required to comply with the various de-

signed mixes.

The unit of measure for proportioning the concrete shall be the cubic foot. Ninety-four (94) pounds (one bag or 1/4 barrel) of Portland cement shall be considered as one cubic foot.

Each of the constituent materials shall be measured separately by volume. The fine and coarse aggregates shall be measured loose as thrown into the measuring devices. Such necessary bunkers and equipment shall be provided and such methods shall be used as will, in the opinion of the Architect, secure the specified proportions of the materials uniformly in each batch.

The moisture content of the sand must be checked by weight, or other approved method, so as to keep the proportion of mortar and the water content uniform.

Concrete for structural purposes, such as slabs, beams, columns, walls of 8" thickness or less, step and stair work, etc., shall be mixed in the proportion of one (I) sack of cement, six (6) cubic feet of dry loose aggregates and the diatomaceous earth admixture measured separately.

Concrete for bulk and heavy work, foundations, walls over 8" thick, etc., shall be mixed in the proportion of one sack of cement, seven cubic feet of loose dry aggregates and the diatomaceous earth.

Consistency: The materials shall be mixed with a minimum amount of water to produce a concrete of such consistency as will allow it to flow sluggishly into the forms, around the reinforcing steel and completely fill the forms with the aid of thorough and careful tamping. The object of this requirement is to get a workable concrete that will produce a uniformly dense and strong concrete. In general the consistency as determined by the standard "Slump Test" shall not be less than two (2) inches nor more than five (5) inches as determined by the Architect for the different parts of the structure.

Conditions may arise in placing the concrete which will require the use of a quantity of mixing water that will reduce the compressi- strength of the concrete below the minimum specified, in which case sufficient additional cement shall be used in the concrete mix to compensate for the reduction in the required strength of the concrete caused by the use of the excess quantity of mixing water.

The use of additional cement in concrete to offset the detrimental effect of excess mixing water will only be allowed with the approval of the Architect, and the Contractor will not be entitled to any additional compensation for such extr a cement used.

Mixing: The mix shall be made by a "full sack batch" machine mixer of type approved by the Architect and each batch shall be run long enough for the conglomerate to become a homogeneous mixture, continuing a minimum time of one (I) minute after the last aggregate has been placed in the mixer. All batches shall be of uniform color and consistency. The mixer drum shall have a speed of not less than (14) revolutions per minute or more than (18) revolutions per minute.

The mixer shall be equipped with a suitable charging hopper and shall have a water-storage and water-measuring device which must be suitable for an accurate and quick control of the amount of water used in each batch. It shall be equipped with a bell device that will ring once when the hopper is emptied into the mixer and twice when the mixer is discharging into the skip. The uniform control of water is essential, and the Contractor must secure the approval of the Architect for the water control apparatus he proposes to use. The entire contents of the drum shall be entirely discharged before recharging.

The remixing of mortar or concrete that has partially set will not be permitted. No concrete shall be deposited in the work which has begun to set and in no case if it has been mixed for a period longer than half an hour.

The capacity of all wheel barrows used in measuring materials shall be plainly marked in white paint on the outside. Emptied cement sacks shall be folded and neatly piled in stacks of 50 for counting by the inspector.

Pre-mixed Concrete: Concrete pre-mixed at a central plant and delivered to the site in carriers may be used in place of the local mixing plant. If this system is used, the mixing at the central plant shall be done under the control of the testing laboratory specified herein and all of the requirements herein for concrete shall be strictly complied with. The charges of the testing laboratory for this work shall be borne by the Contractor.

Placing: Concrete when mixed shall be immediately deposited without any separation of its ingredients and thoroughly tamped so that all parts of the forms are filled and so that no voids remain. If separation occurs during transportation, the concrete must be dumped on a platform and remixed by shoveling before placing in work. Concrete shall be spaded and rodded so as to work it through and under closely spaced reinforcing bars.

The above work must be done in a thorough workmanlike manner to obtain a uniform dense concrete. The Architect will require the Contractor to put on as many tampers as he considers necessary to secure the desired results for the different parts of the structure. Also the forms, beams, etc., shall be vibrated by hammering same as required. Uniform appearance of exposed surfaces must be obtained. Visible pouring lines will not be tolerated. Concrete must not be deposited in water. No vertical pour shall exceed 12'0".

The conveyances, trucks, or barrows must be thoroughly cleaned after each dumping into the forms. Any concrete spilled on the forms or reinforcing steel in portions of the building not immediately concreted shall be completely removed prior to placing the concrete in that portion of the work. If this waste concrete is allowed to get

partly set up it must be removed from the job. Spouting of concrete direct into the forms will not be permitted.

No concrete shall be mixed or placed unless there is an inspector present. Any work placed without inspection may be condemned and removed at the option of the Architect.

Finished Appearance: The exposed exterior walls of the building and the exposed interior walls of the first floor, the stair from the first floor to the second floor and the second floor areas shall be given especial care. The exterior walls will be finished with a cement dash and the interior walls with a cement paint as specified herein, but these coatings are not calculated to cover deficiencies in the concrete work. The placing of this work shall be given special care. Special efforts shall be made with the form work, tamping and vibrating or hammering of the forms so that when the work is stripped it shall present a whole, uniform, smooth surface free from form marks, voids and other defects that might mar its appearance.

Construction Joints: If for any good reason approved by the Architect a slab or floor cannot be poured as a complete monolith and work has to be stopped, it may be stopped at places satisfactory to and in a manner approved by the Architect, generally in the center of a span. The Contractor must submit plan and schedule of pouring operations for approval before starting the concreting. If work is begun on any section it shall be carried on continuously to the line or joint determined upon.

If for any reason approved by the Architect the concrete is allowed to set at any level or on any line before the balance is poured, special care must be taken to break up and remove all laitance and thoroughly roughen, wash and clean and etc. the contact surfaces so th a proper bond will be obtained with the added concrete.

In line with the requirements for the "Finished Appearance" as specified above, the work shall be so arranged that an entire section

can be poured up to a determined level entirely around the building. These pre-determined pouring levels are indicated on the drawings.

Before beginning new work on concrete previously set, the contact surfaces must be thoroughly washed, cleaned and moistened and a good layer of neat cement paste shall be slushed on immediately before pouring concrete. For walls and columns, grouting as specified below shall be used instead of cement paste.

Construction joints in members and slabs shall be reinforced as shown in details on the plans. If not specifically shown, the construction joint shall be reinforced as directed by the Architect.

Grouting: Immediately before starting to pour concrete walls and columns, a uniform layer of grout two (2) inches deep shall be placed in the bottom of all wall forms and four (4) inches deep in column forms. The grout shall consist of one (I) part cement and two (2) parts of sand with enough water added to make a thick consistency.

Patching: Ordinary: Immediately after removing forms all concrete surfaces shall be inspected and any poor joints, faulty moldings, voids, stone pockets, etc., shall then be repaired by cutting out and back to full solid surface and in such manner as to form a key for cement mortar fill. The mortar shall be composed of one (I) part cement and one and one-half (1-1/2) parts sand and shall be thoroughly compacted into place and finished neatly and smoothly on the exposed surface. On exposed concrete finish surfaces the patching shall be done to match adjoining surface and to the satisfaction of the Architect.

Patching: Special: All parts specified herein for special form work shall be given special care in patching after stripping. Expert plasterers shall be employed for this work. Holes and sinkages shall be plastered flush, bulges and projections shall be reduced flush, damaged edges and moldings shall be repaired, the real and false segmental joints in the fluted part of the tower shaft shall be cut and

patched to uniformity, arris edges shall be cut, patched and shaped to correct lines and, in general, all of this special work shall be gone over most carefully and put in satisfactory order and condition. The patching shall be finished to reproduce the color, texture and density of the surrounding concrete.

Curing: All "fresh" concrete shall be protected from the direct rays of the sun, from the drying winds and against wash by rain. All concrete shall be kept soaking wet for a period of ten (10) days after being placed. Cement finish on floors must be entirely covered with a layer of sand at least one (I) inch thick immediately after final set and kept water soaked for a period of two (2) weeks.

Cement finished floors will be tapped or sounded six weeks after they are cured. All hollow sounding areas shall be entirely removed back to such lines as required by the Architect and the defective area re-laid.

Care must be taken not to disturb in any manner the reinforcing material projecting from freshly placed concrete.

Samples and Tests: All designing of concrete mix, central plant inspections of cements and pre-mixed concrete, job inspections and cylinder tests shall be done by a testing laboratory selected by the Architect. All charges for this work shall be paid by the contractor. The Architect will determine the amount and extent of the tests and inspections to be made. Reports on these tests and inspections will be delivered directly to him.

Samples of the concrete aggregates shall be submitted to the Architect for tests and approval before any of these materials are used.

Samples of the mixing water may be tested a the option of the Architect.

The Architect will have samples taken of the

concrete mixture as it is being poured. The samples, which will be taken in the form of standard cylinders (6) inches in diameter and nine (9) inches high, will be tested. The concrete shall develop a minimum compressive strength of not less than 1200 pounds per square inch at the age of seven (7) days and 2000 pounds per square inch at the age of (28) days.

FORMS; GENERAL CONSTRUCTION:

The forms for all concrete work shall be complete and of sufficient strength and construction to prevent any spread, shifting or settling when concrete is deposited therein, and tight enough to avoid any leaking or washing out of cement or sand from the concrete. All form work shall be absolutely true and accurate.

All dirt, chips, sawdust, rubbish, water, etc., shall be thoroughly removed from the forms before any concrete is deposited therein and the forms washed out. No wooden ties nor blocking shall remain in spaces concreted.

The forms shall be made of good sound lumber, free from loose knots, and of sufficient size and strength to withstand all pressure that may be brought on them without bending or crushing. Unless specified otherwise under Special Form Construction, all form lumber coming into contact with concrete shall be 1" x 6" sized on one face and one edge to a uniform thickness and width. Other lumber may be rough. Structural defects shall be cut out and holes stopped with tin patches. The smooth side shall be turned to the concrete.

The plumbing and leveling of the forms shall be attended to by certain competent men specially assigned for the job. Before the pouring of the concrete begins, all forms shall be tested with an instrument for position, both horizontally and vertically. During the pouring of the concrete, the forms shall be watched by these men and they shall correct any displacement or looseness of forms or of reinforcement. No other

work shall be done upon the forms nor shall they be removed in any way after the concrete is in place until the time for removal of forms.

Form boards and forms shall be thoroughly cleaned and repaired before re-using.

Clean-out doors shall be placed at the bottom of all forms at each pouring level. Special attention shall be given to cleaning out the bottoms of all forms before any concrete is poured.

Forms for circular stairs shall be left open temporarily on the treads so that the concrete can be placed without flowing and then tightly closed after the concrete is poured so that pouring may be continuous for the entire slope.

FORMS & SPECIAL CONSTRUCTION:

General: As specified above, the entire exterior of the building is to be finished with a cement wash. This will give the building even texture and color, will cover up patches and will conceal slight deficiencies in the form work. It will not cover imperfect or defective form work. Similarly, the first and second floors and the stairway between are to be finished with cement paint which will not cover any deficiencies in the form work. For these reasons, special care will have to be exercised in building the form work, pouring the concrete, stripping the forms and patchings. Practically perfect work must be produced. Defective concrete work appearing after stripping will have to be cut out and repaired by hand plastering as required and to the complete satisfaction of the Architect.

All form boards coming into contact with the concrete surface of these special parts shall be good quality Douglas Fir or Redwood, shall be surfaced, shall have all defects cut out, all butt joints shall be re-cut to an absolutely square edge and all jointings shall be flush. Certain parts shall be mill made where specified or required. Forms may be shellaced or varnished with waterproof varnish

but no oil or any other compound that might prevent the adherence of the cement wash shall be used. Special surfaces may be lined with galvanized iron or tempered Presswood Masonite. In either case, the sheets shall be used in as large sizes as are manufactured and joints shall be butted. Nail heads shall be driven flush but not countersunk. Where the detail being formed is a vertical design, such as columns, pilasters, etc., the form joints shall be placed vertically. Where a vertical detail is less than 12" wide a single board shall be used.

The following provisions as to special forms are suggestive rather than mandatory. The Contractor may submit alternate schemes, with the provision that the desired results must be obtained and that the schemes must meet the approval of the Architect. Results not methods are important and vital.

Interior work; Special Parts: Include the vestibule, elevator lobby, ~~restaurant,~~ public spaces stairway from 1st to 2nd floor and the public parts of the second floor. In general, this covers all parts of the lower floors to which the public will be given access. The toilet walls behind the tile wainscot should be left rough to receive the tile. The exposed parts above the tile in the toilets may be standard form work, appearance being secondary.

The balance of the interior, closets, ~~kitchen,~~ inner spaces, janitors rooms, stairway from second to lantern floor, elevator shaft, etc., shall be formed with the sound, 1" x 6" SIS-2E Douglas Fir laid up with sufficient care to produce smooth surfaces.

The form lumber against the concrete in the special interior parts shall be 1" x 6" T&G, or sheet metal or Masonite as specified may be used. Butt joints shall be cut square and laid tight and flush. Knot holes shall be cut out. Pronounced slash grain, wanes or similar defects that will show in the stripped work shall be cut out. Angles, edges, arrises and similar forms shall be accurate and carefully formed. All joints shall be flush.

Exterior Work: Exterior work can be considered in three sections:

First: The lesser or smaller ornamental work such as ~~the arches~~ around the main doorway, columns around the ~~restaurant~~ windows, moldings and set backs and buttress, and arch forms from the 412'0" level up.

nd: The plain surfaces of the first & second floors, the tower base, and from the 412'0" level up.

Third: The fluted section of the tower or column extending approximately between elevation 319' to 412' 7-1/2".

First Group: The forms for the special parts of the first group, such as the small columns on the first floor, the engaged columns at the lantern floor and the smaller arches shall be mill made and brought to the job. They must be formed so that they can be stripped without "pinching" the pour. Soffits of arches shall be formed by bending the form material and not by short cross pieces. When the material is the same as that of the jambs under the arches, the form joints of jambs and arches should be continuous.

Second Group: The forms for the second group or the plain surface group shall be formed similarly to the work described for the public parts of the interior.

Third Group: This group includes the main shaft or fluted column. The essential results required are that the shaft shall be tapered from bottom to top, that the arris edges shall be accurately alined, that the surfaces of the different segments shall be in even planze and that the actual joint of the pour of each section shall be accurately level around the shaft.

Each segment of pour is about 11'6" high. This will be marked by a fillet in the forms to make a defined joint. The joint shall be level entirely around the shaft. Midway between the pour joints will be a false joint, using a fillet similar to the one

used for the actual joint. This shall also be level around the entire shaft.

Each flute is about ~~3'-6"~~ 4'-6" from edge to edge of arris, varying as the taper draws in at the top. The flute is formed on the segment of a circle, the concavity being about ~~3"~~ 5" and radius constant for the entire shaft. The joints in the form sections shall occur at the center of the concavity.

The forms shall be mill made in separate sections the full height of the pour section (about 11'6") and the width about 5" less than the distance from center to center of concavity. This distance varies ~~about 2-3/4"~~ from bottom to top. All forms shall be exactly similar in construction, size, form, etc., and each form shall be a separate unit. The variation on the distances of the centers shall be compensated for by wedge shaped staves of variable widths set in at the joint on the concave centers.

Each pour section will require a complete set of form units unless the contractor chooses to alternate the sets; in which case probably two complete sets will be sufficient. Additional or replacement form units should be provided in case of irrepairable damage.

If wood surfaces are used, the boards shall be run vertically and in single lengths. The surface of the boards shall be milled to the radius of the flutes, the edges beveled and T&G. The boards shall be spaced symetrically on each side of the arris edge, any variation coming at the form joint.

The taper and concentricity of the shaft shall be maintained by measurements taken from the central plumb line over the bench mark as specified herein and not by outside measurements or taper-templates.

Special care shall be taken in clamping and anchoring these unit forms in place. Each unit form shall be rigid and strong in itself and its edges shall bear tightly against the adjustable wedge.

A beveled bonding key at least 2" deep and 3-1/2" wide shall be bedded entirely around the top of each pour section.

FORM WIRES:

In placing the form wires which extend through exterior walls, a neat hole just large enough to allow the wire to pass through shall be bored from the inside of the forms. The vertical spacing shall be worked out so that these wires will come at the form board joint line.

Form tie wires through exterior walls must be placed so that they slope downward toward the outside surface of wall not less than one (I) inch.

After stripping the concrete, the form wires shall be neatly cut off, back of the face of the concrete, with a small, sharp, cold chisel, cutting against a steel anvil to prevent spalling, care being taken not to chip or spall the concrete as a minimum amount of pointing will be allowed.

The ends of the wires, before pointing up, shall be treated with a rust retarding material. This material and pointing shall be subject to the Architect's approval.

GUARANTEE OF FORMS:

This Contractor shall absolutely guarantee that ledges, bulges, gravel pockets or other defects will be avoided. When this work is stripped, any defects as above mentioned caused by negligence, faulty or insecure work, must be removed, repaired or refinished, as may be directed by the Architect, at the expense of this Contractor.

REMOVAL OF FORMS:

Forms shall not be removed until the concrete has thoroughly set and in no case until notified by the Architect to do so.

In no case shall shoring supporting the dead weight of concrete, be removed in less than fourteen (14) days after pouring.

FLOOR SLABS:

All floor slabs shall be finished monolithic with structural work. The freshly poured slab shall be screeded and floated to a uniformly even surface and to grades as shown. Care must be taken that the finish is true to grade and there shall be not more than one-quarter (1/4) inch variation from a surface plane in a distance of twenty (20) feet.

Where tile, or cement floors laid separately, or other lithic material is specified and/or shown as a top or floor finish, the structural concrete slab shall be screeded to the proper grade or level. All laitence shall be cleaned off and the surface roughened to form a good bond for the bedding material.

Where areas are shown and/or specified for cement topping laid integrally, this topping shall be laid integrally and incorporated with the slab as specified below.

OTHER TRADES:

The Contractor shall make provision in the forms for all sleeves, hangers, anchors, conduits, etc., required to be placed in the concrete by other trades, before pouring the concrete and shall also verify the location and levels of all such work before proceeding with the concreting. He shall see that all anchors, hangers, etc., for steel furring and similar work are properly placed in the forms.

REINFORCING STEEL AND FABRIC:

Reinforcing steel: The steel used for reinforcing shall be of structural steel quality made by the open hearth process and shall be made in accordance with and conform to the Standard Specifications for Steel Reinforcing Bars of the American Society for Testing Materials Serial Designation A-15 as latest revised. The reinforcing steel shall be free from flaking, scale or coatings, of any character which will tend to reduce or destroy the bond.

All reinforcing bars shall be of sizes called for on drawings. The dimensions given are one side of the square of the net section, except

where round bars are specifically called for. All bars shall be of mechanical bond type and of a kind approved by the Architect. All ba[rs] shall be bent or straight as shown or called for on the drawings, shall be accurately placed and thoroughly wired at intersections and in the form to hold them firmly in place while the concrete is being poured. Extreme care shall be used to set accurately and to hold firmly in place all bars near the top surface of slabs and framing members.

A ll bars at splices shall be thoroughly lapped and splices shall stagger as much as possible. Unless otherwise shown, bars at splices shall lap at least fifty (50) diameters and all splices shall be at column center lines or points of support.

All bars shall be thoroughly protected by concrete as per detailed dimensions shown on the drawings. No steel shall be nearer than one and one-half (1-1/2) inches to the surface unless specially shown.

All steel dowels shall be placed before the concrete sets; not [later than] an hour after the concrete has been poured. Care shall be taken to see that the concrete is thoroughly tamped around the dowels.

The reinforcing steel in the foundation or other concrete resting on the rock shall be hung from supports. In no case will the Contractor be permitted to support reinforcing steel above the rock by the use of rocks, bricks or other materials.

Wherever conduits, piping, inserts, sleeves, etc., interfere with the placing of reinforcing steel as shown or called for the Contractor shall consult the Architect and secure from him, in writing, the method of procedure before pouring any concrete. The bending of bars around openings or sleeves will not be permitted.

Reinforcing Fabric: Reinforcing fabric shall be Clinton Electrically welded or an equivalent satisfactory to the Architect. The mater[ial] shall be as specified for reinforcing steel. Unless shown or specified otherwise it shall be 6"x6" mesh and #10-#10 wire. It shall be new and un-

rusted. The edges shall be butted, and the ends lapped 6" or anchored to abutting construction as the condition may require.

INSPECTION:

A ll cement, reinforcing steel, and other materials entering into the work shall be subject to inspection and tests made under the supervision of and as directed by the Architect. The materials will be subject to the approval of the Architect and no materials, if disapproved, shall be delivered to the work or used therein, but shall be forthwith replaced by approved material. All costs of the sampling, testing and inspecting of materials and of mixed concrete will be paid by the Contractor. The testing laboratory will be selected by the Architect.

DENSIFYING:

The concrete in the following parts of the building shall be "densified" or "super-densified" as specified above.

The Parts to be Densified are: All parts where special form work is required as specified above, except the outer walls of the fluted shaft, pilasters and columns.

All concrete foundations below finished grade and interior concrete slabs resting on earth, rock or filling.

This in general includes all outer walls of the building except the parts to be super-densified.

The Parts to be Super-densified are: All of the outer walls of the fluted shaft, all pilasters and engaged columns and all columns.

The Rest of the Concrete Work: Shall be admixtured with 1-1/2" lbs. of diatomaceous earth as specified.

BENCH MARK:

The Contractor shall place a semi-permanent bench mark at the exact center of the circular tower. After the elevator pit is excavated and finished, the contractor shall employ a licensed surveyor to set

this bench mark in the pit. The location of this bench mark shall determine the location of the tower foundations and the tower walls. As e[illegible] circular segment is formed a plumb line shall be dropped to the mark and the exact concentricity of the circular walls established from that center. Under no circumstances shall the circumference be established by outside measures, plumbings or similar methods.

WATERPROOFING:

Membrane waterproofing is included in another section of these Specifications.

REGLETS: (Used 1 1/8" bottom - 1 5/8" back. O.K.)

Reglets shall be cut from 2" x 3" No.1 common Douglas Fir ripped down the center and the remaining 1-1/2" x1-1/2" pieces diagonally ripped to form pieces with 1-5/8" bottoms and 1-1/2" backs. Drive 6d common nails in backs at 12" intervals to form anchors.

Reglets shall be set in the concrete walls with their bottom 4" above roof finish around all concrete walls rising above roofs of any kind, around exterior floors that are to be membrane waterproofed and elsewhere as shown or directed.

Smaller reglets 3/4" x 3/4" shall be set where shown or directed to receive metal flashings, etc.

FLOOR FINISHES:

General: In general, there will be four classes of floor finishes;

(a) Where the finished floor is tile or similar lithic material. In this case, the rough slab shall be brought to the required level with screeds, all projections shall be forced below that level, and finished as specified above. Allow the following levels below the finished floor level which distances are minimum.

Quarry tiles	- 2-1/2" down or more.
Ceramic tiles	- 1-1/2" down or more.

(b) Where membrane waterproofing is to be laid on concrete slabs forming roofs or exposed decks or floors. In this case,

backfill, shall b composed of concrete 4" thick and continuously re-inforced in every direction with electrically welded galvanized wire cloth 3" x 3" mesh #8 x #8 wire. This crack control, temperature re-inforcing shall be placed midway between the top and bottom of the 4" concrete slab and each individual section of same on all sides shall be lapped 1-1/2 full meshes (4-1/2") on each adjacent sheet.

CURING:

After laying, all interior cement floors shall be covered with Sisalkraft paper applied as directed by the manufacturers. This shall be maintained continuously in place in good order until the completion of the structure. Exterior floors shall be covered with wet sand.

REPAIRS:

Six weeks after cement floors are laid, they shall be tapped and sounded under the direction of the Architect. Hollow spots shall be removed back to such lines as are required by the Architect and the defective work relaid.

FILLING-IN:

All depressions in slabs, not otherwise filled, shall be filled as directed or required.

LININGS:

Floors of the Class C & D type shall be lined off. The lining shall be done with a special tool cutting not less than 3/4" deep and leaving a small V on the surface. Angles shall be accurate and true and intersections sharp and clean. Linings shall be run about 18" on centers depending on the space. Border lines shall be run as directed.

LOCATION:

The various types of floor finish for the various areas shall be as follows;

TYPE A: Throughout the vestibule, elevator lobby, phone room, three areas of the restaurant, two toilets on the first floor,

<u>Type B</u>: Roofs or terraces, roof over entrance and vestibule, of the second floor, outer rim or deck of Belvedere floor, Plan G-G; Roof Plan, Plan I-I. The ~~corner~~ ~~decks~~ deck over Vestibule ~~of Plan D-D~~ shall be concrete finished smooth to take a copper roof with flat seams, and wood cleats shall be set accordingly. ~~These four~~ This ~~decks~~ deck will not be membrane waterproof. The cement steps and the landing from H-H to I-I shall be included in the parts to be membrane waterproofed, but shall be finished with cement as specified for the concrete step finishes. (See Detail Sheet #8).

<u>Type C</u>: On all other floors not included in Types A, B or D.

<u>Type D</u>: On all of the ~~kitchen~~ inner area, first floor.

<u>CONCRETE STEPS</u>:

The rough slabs and risers shall first be formed integral with the building construction. The surfacings shall be not less than 1-1/2" thick in any part and laid separately from the rough concrete. They shall be composed of one part of cement, two of sand and one part of fine topping gravel with the specified earth admixture.

Concrete steps shall be formed with a square nosing, slightly rounded as directed. All steps shall pitch 1/8" to the front. No more and no less.

Surfaces shall be true to plane and angles and edges accurate and unbroken. Step finishes shall be cured as specified for cement floors.

The treads of the stairs from the first to the second floor and from H-H to I-I shall be treated with non-slip aggregates as specified for Class D floors, except that the aggregates shall be applied at the ratio of one pound to each square foot. The risers shall be trowelled smooth. Tread margins without the non-slip aggregates shall be left as specified for rough finished steps.

All other treads shall be finished by being trowel-roughened or

brush stippled as directed. Margins trowelled smooth shall be left at sides, back and fronts, leaving 4" at each side or end, 2" at the back and 1/4" at the nosing.

The combination cement and brick-mat steps and landing at the main or north entrance shall be included in the Brick and Structural Tile Section of these Specifications. The rough form or core for these shall be included in this Section.

The concrete and cement finished steps and buttresses at the south elevation shall be included in this Section. They shall be constructed as specified above and finished with rough troweling or brush stipple.

The concrete and cement steps at the casement windows of the restaurant and other steps from inner to outer areas shall be constructed as specified and finished with the rough-trowel or brush stipple as directed.

BURIED ANCHORS:

The tower piers shall be anchored to the rock as shown. Rock borings are specified in the Excavating and Grading Section of these specifications. The anchors shall be placed in the bores and grouted in place with a grout of one part of cement to three of sand, placed as dry as practicable and thoroughly rodded and tamped in place with steel rods.

SCUPPERS:

Emergency overflow scuppers shall be placed near each roof outlet. These shall be salt glazed, vitrified sewer tiles, 3" in diameter. They shall be set with the bell end on the inside and flush with the concrete. The lower level of the pipe at the inside shall be 2" above the roof level at that point. The outer end of the pipe shall project 1" beyond the concrete and cleanly cut and ground smooth.

~~PUMP HOUSE:~~

PUMP-HOUSE:

The small pumphouse (See Sheet #1) at elevation 245'(approximately) shall be constructed and finished as specified for the main building. The wall, roof and floor sections shall be formed as shown. All of this work shall be reinforced. The inner walls shall be hot-coated with two coats of hot asphalt. The roof shall be entirely covered with composition roofing as specified in the "Membrane Waterproofing" Section. The exposed face walls shall be cement plastered. The door and frame shall be metal covered. After the building is completed, the excavations shall be backfilled.

CAST STONE

The work required under this Section includes all labor, materials, tools, equipment and services necessary for the furnishing, installation and finishing of cast stone ~~grilles~~ as ~~are~~ is shown, indicated or noted on the drawings and/or specified herein.

SAMPLES:

This Contractor shall submit a sample of the cast stone which he proposes to use. This sample shall show the extreme variation in quality, color and texture that will occur in the stone used and said sample shall be clearly marked on the back with the name of the Contractor, name of the structure and date.

MODELS:

From the drawings, full size models shall be executed by a modeller who is acceptable to the Architect. ~~This~~ The model or models shall be submitted to the Architect for approval before any work is executed therefrom. Allow $400.00 for modeling & plaster casts.

MANUFACTURE:

~~These~~ The cast stone ~~grilles~~ shall be composed of Portland cement, crushed marble or granite and such other ingredients as may be necessary to faithfully reproduce the color and texture of the approved sample. The proportion of aggregate to cement measured by volume shall not be over five (5) parts nor less than 3-1/2 parts. The cement and aggregate shall be mixed in the proper proportion by the wet process and the aggregate so graded as to produce a stone of maximum density and homogeneous throughout. The frames and fret work of ~~these~~ the cast stone ~~grilles~~ shall be rigidly reinforced in every direction with hot dipped galvanized 1/4" square deformed steel bars.

~~These~~ The cast stone ~~grilles~~ shall be properly cured and shall have sharp well defined surfaces and arises and shall be composed of material which will have a compressive strength of not less than 5,000 lbs. per

square inches on 2" cubes. The cast stone shall have a water absorptio.. not to exceed 4% of its dry weight, after being dried to a constant weight at 150 degrees Fahrenheit, and under ordinary immersion for a period of one hour.

RE-CUTTING:

The cast stone shall be re-cut and touched-up as the Architect may require.

INSTALLATION:

This Contractor shall set and securely anchor ~~these~~ cast stone ~~grilles~~ in place, in cement mortar when and in a manner all as directed by the Architect.

AMOUNT:

Items to be cast in cast stone shall be One plaque, two fasces, two grilles. toilet windows, Balusters in plan G-G.

CEMENT FINISH

WORK INCLUDED:

This Section of the Specifications shall include the furnishing of all material, appliances and equipment necessary and applying and finishing complete of all Cement Finish to the exterior of the building as is shown, indicated or noted on the accompanying drawings and/or specified herein.

MATERIALS:

Previously specified: Portland cement and ordinary sand are specified in the Concrete Section of these Specifications.

White Cement: White cement shall be Medusa or Atlas white cement with integral waterproofing.

White Sand: White sand shall be Monterey White Sand.

SAMPLES:

The Contractor shall prepare and apply samples of the finished work on such parts of the building as the Architect may direct. Accurate records shall be kept of each mix. The samples shall be about 24" x 36". When a sample has received a final approval, a record sample shall be made on wire cloth on a wood frame and cement undercoat to replace the concrete surface.

PROTECTION:

All openings shall be protected with mats of building paper on wood frames. All dashing shall be finished before any roofing tile, copper roofing, etc., is set. All construction not to be dashed shall be adequately protected, and in case of any spattering, the construction shall be thoroughly cleaned and restored to the satisfaction of the Architect.

APPLICATION:

General: The entire exterior of the building, including all plain

walls, ornaments, reveals, pilasters, engaged and free standing columns, backs of parapets, etc., shall be finished to a uniform color and tex[ture].

The finished work shall be so arranged that each day's work shall terminate at a natural boundary or stopping place, such as sill courses, parapet copings, band courses, etc. In the case of the fluted portion of the tower stoppings may be made at the segmental joints. In any event where work is stopped and resumed the joining must be invisible.

All work shall be started at the highest point and carried on down. In the case of the round part of the tower (from the 2nd floor up) the dashing shall go entirely around a section stopping at a horizontal line and having no vertical joint.

Sufficient workmen shall be used to permit the working of four or more gangs on a level.

__Cleaning:__ The concrete shall be thoroughly cleaned and scrubbed down, using hose and a stiff broom and thoroughly wetted and soaked.

__Wash:__ While the surface is still wet, apply a cement wash. Use one part of Portland cement to two parts of ordinary sand mixed to a consistency of thick cream. Brush it on thoroughly with a short handle broom. Allow it to set.

__Dash:__ Wet the cement wash and apply a dash coat. Use one part of white cement to two parts of white sand according to the selected and approved formula. Apply with short handle brooms and bring to the required texture.

__WASHES:__

All level places, washes, etc., such as tops of parapets, sills, and similar places and the area between the wall and the outer parapet shown on Plan D-D shall be coated at least 1-1/2" with the dash mixture and trowelled smooth. In the case of the parapets the wash shall deliver to the inside. In the case of the wash on Plan D-D, the drainage shall be to the small corner roofs.

__HUNG CEILINGS__:- See Addenda No1 - Pg. 2. Vest. & Elev. Lobby Ceils
- Omitted

CARPENTER & MILLWORK

WORK INCLUDED:

This Section shall include the furnishing, setting and finishing of all Carpenter and Millwork as is shown, indicated or noted on the accompanying drawings and/or specified herein. This shall also include the furnishing and setting of all rough hardware, and the setting of finished hardware, the hanging of all doors, both wood and Kalamein covered, and the furnishing and setting of all doors, Kalamein doors are included in the Sheet Metal Section of these specifications, but the hanging of the doors shall be included in this Section.

MATERIAL:

Rough Carpentering: All lumber used for rough carpentering, rough bucks, blocks, reglets and similar work shall be #1 Common Douglas Fir. Wherever this material comes into contact with or is set in concrete, it shall be thoroughly coated with hot creosote.

Front doors: The pair of front doors shall be constructed with best quality, clear, straight grained Sugar Pine throughout, except the astragals which will be straight grained Eastern White Oak.

Other Millwork: All other millwork, door trim, ~~vestibule screen,~~ etc., shall be best quality #2 Clear and Better vertical grained Douglas Fir free from slash grain, knots, roughnesses, etc. It shall be mill sanded and the moldings shall be hand sanded.

ROUGH CARPENTER WORK:

General: The carpenter sub-contractor shall furnish and set in the forms or shall superintend the setting of all reglets, nailing blocks, rough bucks, etc., necessary for the attachment and support of all items attached to concrete. This included any rough backing and similar work for the mechanical work. Where such items are attached to and not bedded in the concrete, they shall be fastened by means of bolts and expansion shields. Plugging will not be permitted.

Bucks: Bucks in concrete shall be bedded flush. Bucks on the jamb side of doors shall be reinforced with 1/2" x 8" square head bolts with one end turned up 2" in the concrete and the head countersunk flush. One bolt shall be placed at each hinge point. Bucks in tile work shall be anchored to the tile joints with approved anchors.

(1/8" letters - 1 3/8" backs)

Reglets: Reglets shall be formed as specified in the Concrete Section.

(laid without cleating) over the Vestibule

Copper Cleating: The ~~four~~ small roof~~s at Plan D-D and the parts of the roof adjacent to the Vault Lights Plan C-C~~ will be covered with copper as specified in the Sheet Metal Section of these Specifications. 1" x 2" stripping set as required by the sheet metal worker shall be bedded in the concrete of these areas.

Other Rough Carpenter Work: Other rough blocking, nailing cleats, etc., shall be furnished and set as required for proper anchorage.

MILL WORK:

General: All mill work shall be produced by a San Francisco planing mill. All mill work shall be the best quality in the market and shall be produced and installed by skilled mechanics. All work practicable shall be done at the mill, requiring only cutting and fitting at the building. All work shall be accurately fitted and cut and shall be produced and installed in strict accordance with the drawings and to the complete satisfaction of the Architect. All standing trim shall be milled with hollow backs.

All nailings shall be countersunk. All mill work set against concrete shall be primed on the back before setting and shall not be set until the concrete is bone dry. Any exterior mill work shall be primed on all faces and edges before setting. Joints

shall be coped and mitred. Casings shall be mitred and back fastened with metal clamps. All jointings shall be flush, accurate and true.

Front Doors: The front doors shall be manufactured entirely of sugar pine with oak astragals. Rails and stiles shall be solid. Panels shall be solid and not less than 13/16" thick. They shall be set into the frame with splines and applied moldings set in white lead. The rails, stiles and the cross rails and cross stiles shall be accurately fitted together , tongued, dowelled and glued with waterproof glue. All joints shall be flush, angles accurate and surfaces out of wind. The door must lie flat against the stops. Sizes, patterns, etc., shall be as shown.

Other Doors: Doors other than front doors or Kalamein doors shall be manufactured entirely of Douglas Fir. They shall finish 1-3/4" thick net. Stiles and rails shall be run out of the solid, shall be full glued, dowelled and tongued together. Panels shall be three plies, grains being crossed, and shall be not less than 5/8" thick. Panels shall be assembled into the stiles and rails. Sash doors shall be fabricated with one side rebated to receive the glass and with loose, mitred stops on the other side. Doors must be without wind. Any door forsaking the stops at any point more than 1/4" shall be rehung to remove the wind or replaced with a new door.

1 1/2" used

Door Frames: Door frames shall be run out of 1-1/8" stock with adjustable, inset T mold forming the rebate. They shall be set accurately and true and well fastened to the bucks, especially at the hinge points.

(do)
Cut to 48" to suit hinges

Stall Doors: These doors shall be 1-1/8" thick, 24" wide and 60" high. They shall be flush panel, with Douglas fir veneered on both sides on a Douglas fir frame. Veneering shall be applied with waterproof glue and set under hydraulic pressure. Edge veneer shall be a

full 7/8" thick.

GRILLES & GRILLE DOORS:

There are ~~two grilles or screens between the vestibule (east and west end) and the Restraunt.~~ A pair of grille doors between the Vestibule and the Elevator Lobby, and a pair of grille doors between the Elevator Lobby and the stair entrance ~~and a grille over the hot air inlet between the Lobby and Kitchen.~~ The general construction of this grille work is shown on Sheets #4 and 8. All of the wood used in connection with this grille work shall be clear sugar pine or Port Orford white cedar, except the astragals of the doors which shall be eastern white oak. The grille cutting shall be clean, sharp and accurate. The joints shall be strongly and accurately made. The entire construction shall be carefully smoothed and sanded. The swinging grille panels shall fit snugly into the frames for mutual stiffenir Metal frames for holding the 1/4" glass shall be #14 gauge brass or bronze. One member of each frame shall be set with countersunk screws to permit removal of glass.

The doors shall be specially made to secure the maximum strength and rigidity. Each rail end shall be full tenoned, wedged and glued into the stile. The doors shall be reinforced on each face and on each corner with 12" x 12" galvanized angles made of 5/16" x 1-1/4" metal, and each leg shall have five 1-1/2" galvanized screws countersunk. The circle head doors shall be further reinforced on the hinge side on each face and at the center and top rail with 15" x 12" galvanized Ts made of 5/16" x 1-1/4" metal. The legs shall have six screws and the tongues five screws. Screws shall be 1-1/2" galvanized and countersunk. These reinforcing angles and Ts shall be countersunk flush in the woodwork. Arrange the jamb reinforcing for the hinges so that the hinge screws will clear the reinforcing screws.

WALKWAYS:

Place rough walkways of 2" x 12" joists or strings and 1" x 6" cross pieces set 1" apart from tank to tank where shown. Set a rough hand rail to each walkway.

METAL COVERED DOORS:

Five doors & trim as specified in Sheet Metal Work Section will be finished with copper Kalamein and the cores and trim for those doors will be included in that Section. ~~Two doors from furnace room to vestibule and kitchen and~~ one door from Machine Room Plan H-H will be metal covered on the back and the~~ir~~ inner trim will be metal covered. The~~se~~ door~~s~~ shall be included in this section. ~~They~~ It shall be fabricated as specified for other standard inside doors, except that the~~ir~~ back~~s~~ shall be flush and that there shall be an air vent~~s~~ in the bottom rail of ~~each~~ the door. Th~~ese~~is vent~~s~~ shall be 8" x 18" opening and covered on the wood face side with a stamped steel grille~~s~~.

FILL UNDER COPPER ROOFS:

The structural slab under the copper roof area~~s on Plans C-C and D-D~~ on plan CC will be finished level. The pitch for the drainage and for holding the stripping shall be made with a "one to seven" concrete fill similar to that specified under Ornamental Tile. This shall be laid over the concrete. It shall be not less than 2" thick in any place. The strips shall be bedded therein.

MEMBRANE WATERPROOFING

WORK INCLUDED:

This Section shall include the laying and finishing complete of all Membrane Waterproofing as shown, indicated or noted on the accompanying drawings and/or specified herein.

LOCATION OF THE WORK:

Membrane waterproofing shall be laid over all exterior decks and roofs that are to be finished with quarry tile and that are exposed to weather or water conditions. Membrane waterproofing shall be applied over the following areas:

Second Floor - Plan C-C: All of the terrace or roof areas, including the run-ins or vestibules to the two doors, and all of the upper roof level over the entrance except where copper is ~~vault lights are~~ used.

Belvedere Plan G-G: All of the outer rim from the wall to the parapet.

Roof - Plan I-I: All of the flat areas within the parapets.

Under the stair construction from H-H to I-I including the lower I-I landing. Especial care must be taken with this stair area.

The above includes all roofs and decks exposed to weather or water conditions, except where copper is used. on Plan C C ~~except the corner decks on Plan D-D, and the parts adjacent to the Vault Lights on C-C.~~

PREPARATION OF SURFACES:

Surfaces to be covered with membrane shall be reasonably dry and smooth. Projections of any kind shall be smoothed down and depressions, voids, etc., shall be filled flush with cement.

to the weather shall be made permanently watertight. Suitable provisions shall be made for expansion and contraction without causing leaks. The edges of all copper that are to be soldered, shall first be tinned at least 1-1/2" on both sides. Rosin shall be used as a flux.

COPPER WORK:

Location: The Small ~~four corner~~ decks, ~~Plan D-D and parts of the roof~~ on Plan C-C ~~adjacent to the Vault Lights~~ shall be laid with a flat seamed copper roof, ~~and there shall be three ventilators as shown, on these roofs.~~ All base flashings and counterflashings shall be copper. Doors and their trim (listed below) shall be kalameined with copper.

Expansion Joints: Expansion joints where shown and/or specified for the tile deck roofs ~~and for the vault lights~~ will be included in those sections, but the sheet metal worker shall co-operate with those trades to the end of securing absolutely watertight connections between the various installations.

Insulation: All copper shall be insulated from ferrous metals or conditions of any kind with 2 lb. sheet lead covering the entire area of the insulated part, or the copper may be lead coated. Lead coating shall be done where copper is clamped into deck drains.

Reglets: Wood reglets shall be provided as specified in Concrete and Carpenter Sections of these Specifications. These will be set in the concrete walls, parapets, etc., entirely around all roofs, decks, etc., that are exposed to weather or water conditions, where membrane waterproofing is used and where roof tiling is used. In these cases, the membrane waterproofing will be carried up to the base of the reglet and backflashed with flax pasted in place. Where copper roofing is used on the decks of Plans C-C and D-D, the copper deck will rise to the reglet and act as a base flashing.

Counterflashings: Counterflashings shall be set around all roofs

~~pivoted damper. The damper shall be operated by a chain from the 1st~~ floor. It must work positively and easily. The ventilators shall be fitted with a stamped circular collar to rise between the ventilator collar proper and the added collar. This stamped circular collar shall extend over the copper covered curb and down on the outside of the same about 3" making a complete weather and storm proof housing. If the ventilator construction needs anchoring to the curb, it shall be done by means of four brass bolts and expansion shields let into the concrete.

These three ventilators shall be connected to the ceiling of the kitchen and furnace room respectively with 18" diameter pipes made with #20 oz. copper. The pipes shall be made with slip joints and shall be air tight. They shall finish flush at the ceiling, and the joint between the cement and the pipe shall be covered with 2" circular flanges. The pipes shall be offset through the 2nd floor rooms as shown to clear the windows. They shall be secured to the walls at 48" intervals with 1/8" x 1-1/4" copper bands bent around the pipes and secured to the ~~concrete with brass bolts and expansion shields.~~

GRAVEL STOPS: The roof of the pumphouse (Sheet #1) shall be outlined with a gravel stop made of #24 gauge galvanized iron. The lower edge shall extend down over the concrete about 2" and shall be finished with a crimped edge. The bend shall rise 5/8" above the roof flange. The roof flange shall extend back on the roof. Corners shall be accurately cut and soldered.

KALAMEIN WORK:

Location: The following doors and their trim shall be covered inside and out with copper Kalamein work:

Two doors vestibule to roof deck - 2nd Floor - Plan C-C
One door from vestibule to deck - Belvedere - Plan G-G
One door from landing to roof stair - Plan H-H
One door from pump house to driveway - Sheet No. 1

Cores: Cores shall be clear sugar pine and 1-3/4" thick including the metal covering. Rails and stiles shall be dowelled and glued together and the joints formed with tongue and groove. Panels shall be laminated and not less than 1/2" thick. Wood molds shall be in single pieces. Molds for glass stops shall be separate frames, set with ov[illegible]

headed screws. Where panels are set in rails and stiles, the rails and stiles shall be rabbeted on one side and the panels set in and finished with the stop.

Covering: Copper for rails and stiles shall be 20 oz., for panels and moldings 16 oz. Metal shall be rolled and re-rolled and shall be absolutely flat. Metal shall be drawn over the cores by machine and clamped at all edges and crimped into the wood. All flat surfaces over 4" wide shall be glued to the wood with a waterproof glue when drawn through the mechine and then placed under hydraulic pressure. Panels shall be covered with metal to the full depth of the rebate. Each piece shall be covered with one full piece of finished metal and no joint shall show in a finished piece. Mitres shall be filled and rubbed smooth. Solid panels shall be soldered in place and the covering molds screwed in place with oval headed brass screws. Glass panels shall be provided with one loose frame stop screwed in place. After the doors and frame moldings are assembled, they shall be carefully cleaned down to the raw copper and to an even color and all solder shall be removed. Then all copper work shall be given one coat of pyroxlin lacquer.

Metal trim: Metal trim and staff molds around these doors shall be constructed, set and finished as specified for the doors. It shall be set with caulking compound between the molds and the cement to form an absolutely watertight and airtight connection.

Hardware: Hardware for these doors will be included in the hardware section of these specifications. Its cutting and fitting will be included in this Section and its setting will be included in the Carpenter Section.

GALVANIZED IRON WORK:

~~and~~ one door from Machine Room Plan H-H

Location: ~~Two doors to the heater rooms first floor~~/and ~~their~~ //3 adjacent trim shall be metal covered on the side toward the ~~heater~~ room. The wood part of the door and the trim will be included in the Carpent-

or section.

Covering: The covering shall be #28 gauge galvanized iron. This shall be applied in as large sheets as is practicable, blind nailed to the wood and the edges neatly turned over the edges of the door and trim and flash nailed in place with brass tacks 1" on centers. The work shall be finished flat and smooth.

VENT PIPE FLASHINGS:

Pipes rising through copper decks shall be flashed and counter-flashed with copper. The base of the rising sleeve shall be soldered to the copper and the sleeve shall rise not less than 6" up on the pipe and shall fit closely thereto. The pipe shall be counterflashed with a copper sleeve covering the rising sleeve at least 4" and the turn-in at the pipe shall be smoothly and carefully swaged on the inside of the pipe to give the maximum aperture.

Pipes rising through tiled areas shall be similarly flashed and counterflashed, except that the base shall be cemented with asphalt and flax to the waterproof membrane and the counterflashing shall go down through the tile to the fill under.

ROOF TILING

WORK INCLUDED:

This Section of the Specifications shall include the furnishing, laying and finishing of all Roofing Tile as is shown, indicated or noted on the accompanying drawings and/or specified herein.

LOCATION OF THE WORK:

The areas to be covered with roofing tile are as follows:

Second Floor: Plan C-C: All of the terrace or roof areas, including the run-ins of the two door vestibules, and all of the upper roof level over the entrance, except the part where ~~vault lights and~~ copper is ~~are~~ shown.

Belevedere: Plan G-G: All of the outer rim from the wall to the parapet.

Roof Plan: Plan I-I: All of the flat surfaces within this outer p parapet walls. The landing at the foot of the steps will be finished with cement.

MATERIALS:

Previously Specified: Portland cement, sand, aggregated and admixtures are specified in the Concrete Section of these Specifications.

Tiles: Roofing tiles shall be promenade or quarry roofing tiles. They shall be select grade, unglazed, hardburned and dense grained. They shall be free from imperfections, cracks, warps and the edges and faces shall be true and straight and the corners accurate. They shall be 6" x 9" in size and at least 3/4" thick in the thinnest part. They shall have 1/8" high ridges or corrugations for anchorage. Color shall be red and the run of the kiln except excluding light russets.

Building Paper: Building paper shall be heavy weight glazed building paper weighing not less than 37 lbs. per 500 square feet.
(Out of the Market. J-44 35 featured.)

(Membrane finished with 1/2" sand cement - in place of cement. Paper laid directly ~~sheet~~ on.)

LAYING ROOFING TILE:

All membrane waterproofing shall be covered first with 1/4" dry sand and then with building paper lapped at least 3" at all edges and ends. On this shall be placed a concrete fill consisting of one part of Portland cement to nine parts of 1/2" rock aggregates and sand and "super-densified". The finished pitch of the floor shall be gained by varying the thickness of this fill which must be not less than 2" thick at any place. The tile shall be bedded in this concrete before it has taken its set. The bedding mortar shall be one part of Portland cement to three of ordinary sand and "super-densified". Tile shall be laid with 1/2" joints. Joints shall be broken in regular bond, their direction to be as directed or shown. Each tile shall be shoved in place in a full bed of mortar bonding with the concrete fill. Their tops shall be brought to an exact plane to provide an even slope to all drains. After setting, the joints shall be grouted flush and even with the tile tops and then pointed with a slight depression. Close and accurate connections shall be made with all projections abutting or piercing the tile decks or rising therefrom. All tile cuttings shall be neatly and accurately done with straight even edges and all fittings shall be close and accurate. After setting, all tile shall be cleaned and smoothed down.

EXPANSION JOINTS:

Expansion joints shall be provided and set between tile and all flashings or counterflashings along the walls and wherever else they may be required to take care of tile and tile joint expansion. Expansion joints shall be put in at right angles to the walls or radially depending on the location. On the 2nd floor deck, these joints shall be placed at the lines of the square super structure prolonged, six in all and at the three high point ridges at right angles to the super structure. On the upper circular decks, Plans G-G and I-I they shall be set radially, four to each deck.

Joints shall be made with 18 oz. copper formed in valley or U shape with the flanges bedded under the tile, into reglets or under other flashings as the case may require. The joints shall be a full 1/2" wide and shall extend through the fill to the paper. These joints shall be filled flush and full with plastic asphalt cement, complying with U.S. Government Standard Specifications #380.

OVERHEAD WORK:

No tile shall be laid until all overhead work, cement dashing, etc. is completed and the scaffolds removed.

Primer: Hill-Hubbel- G.A Corp..
Bitumine 7102
Finish " " " 7005

Copper was omitted, at a price, and joints reduced to 1". Primed, and filled. Used Hill-Hubbel- Bitumine Primer 7102 - and filler 7005

MISCELLANEOUS IRON WORK

WORK INCLUDED:

This Section of these Specifications shall include the fabrication, setting and finishing complete of all Miscellaneous Iron Work as is shown, indicated or noted on the accompanying drawings and/or specified herein.

WORK NOT INCLUDED:

The supports for the tanks, the pans under the tanks and the tanks will be included in the Plumbing Section of these Specifications.

GALVANIZING:

All iron used for exterior work shall be galvanized by the hot-dip process unless it is already galvanized in the fabrication as in the case of pipe rails. After galvanizing, the metal shall be cleaned off, smoothed down, left free from all roughnesses and finished with an even color. All bolts connected with exterior metal work shall be sherardized. Expansion shields may be wrought iron and not galvanized.

RAILING WORK:

Rails at ~~Restaurant~~ public space Windows: Rails and uprights for the ~~Dining Room~~ public space windows shall be as shown. The concrete shall be drilled and the rails and uprights set in not less than 3".

The joint between the horizontals and the verticals shall be made with blind pins and welded. The rail at the central south window opening on the south steps shall be as shown and sizes as marked. They shall be stiffened with braces at the newels.

Where iron ends enter concrete, the end shall be turned up for further anchorage or a transverse pin shall be welded to the end. The setting holes shall be grouted full with cement.

(Membrane finished with 1/2" bank sand - in place of cement. Paper laid directly ~~street~~ on.)

LAYING ROOFING TILE:

All membrane waterproofing shall be covered first with 1/4" dry sand and then with building paper lapped at least 3" at all edges and ends. On this shall be placed a concrete fill consisting of one part of Portland cement to nine parts of 1/2" rock aggregates and sand and "super-densified". The finished pitch of the floor shall be gained by varying the thickness of this fill which must be not less than 2" thick at any place. The tile shall be bedded in this concrete before it has taken its set. The bedding mortar shall be one part of Portland cement to three of ordinary sand and "super-densified". Tile shall be laid with 1/2" joints. Joints shall be broken in regular bond, their direction to be as directed or shown. Each tile shall be shoved in place in a full bed of mortar bonding with the concrete fill. Their tops shall be brought to an exact plane to provide an even slope to all drains. After setting, the joints shall be grouted flush and even with the tile tops and then pointed with a slight depression. Close and accurate connections shall be made with all projections abutting or piercing the tile decks or rising therefrom. All tile cuttings shall be neatly and accurately done with straight even edges and all fittings shall be close and accurate. After setting, all tile shall be cleaned and smoothed down.

EXPANSION JOINTS:

Expansion joints shall be provided and set between tile and all flashings or counterflashings along the walls and wherever else they may be required to take care of tile and tile joint expansion. Expansion joints shall be put in at right angles to the walls or radially depending on the location. On the 2nd floor deck, these joints shall be placed at the lines of the square super structure prolonged, six in all and at the three high point ridges at right angles to the super structure. On the upper circular decks, Plans G-G and I-I they shall be set radially, four to each deck.

ROOF TILING

WORK INCLUDED:

This Section of the Specifications shall include the furnishing, laying and finishing of all Roofing Tile as is shown, indicated or noted on the accompanying drawings and/or specified herein.

LOCATION OF THE WORK:

The areas to be covered with roofing tile are as follows:

Second Floor: Plan C-C: All of the terrace or roof areas, including the run-ins of the two door vestibules, and all of the upper roof level over the entrance, except the part where ~~vault lights and~~ copper is ~~are~~ shown.

Belevedere: Plan G-G: All of the outer rim from the wall to the parapet.

Roof Plan: Plan I-I: All of the flat surfaces within this outer parapet walls. The landing at the foot of the steps will be finished with cement.

MATERIALS:

Previously Specified: Portland cement, sand, aggregated and admixtures are specified in the Concrete Section of these Specifications.

Tiles: Roofing tiles shall be promenade or quarry roofing tiles. They shall be select grade, unglazed, hardburned and dense grained. They shall be free from imperfections, cracks, warps and the edges and faces shall be true and straight and the corners accurate. They shall be 6" x 9" in size and at least 3/4" thick in the thinnest part. They shall have 1/8" high ridges or corrugations for anchorage. Color shall be red and the run of the kiln except excluding light russets.

Building Paper: Building paper shall be heavy weight glazed building paper weighing not less than 37 lbs. per 500 square feet.

(Out of the Market. J-M 55 featured.)

to the concrete with countersunk bronze bolts and expansion shields set not more than 18" on centers and staggered.

There shall be extruded or cast bronze thresholds placed at each of the casement windows in the ~~restaurant~~ public space as shown. These shall be placed at the opening parts only.

There shall be extruded or cast bronze thresholds placed at the exterior Kalameined doors, from the tower to the roofs and decks; two on the 2nd floor, one on the Belvedere - Plan G-G, one on the Machine Floor - Plan H-H.

These shall be formed and set as specified for the front door threshold.

<u>Stair Rails - 1st to 2nd Floor & from Plan G-G to I-I:</u> Hand rails for the stairway first to second floors and from Plan G-G to I-I shall be double, one on each side. They shall be made with 1-1/2" galvanized iron pipe and all supports, connections, etc., shall be galvanized. The spiral shall be accurately shaped and shall run the full length of the flight. Connections to the wall shall be made with heavy galvanized iron flanges nipples and plain tees set not more than 5'0" in centers. Bolts into the concrete shall be sherardized or galvanized and expansion shields may be plain wrought iron. Expansion shield shall be used and plugging will not be allowed. The ends shall be finished with cast terminals screwed on the rail. All connections shall be screwed joints and not more than two threads shall show at any joint. After setting, all of the work shall be gone over and carefully smoothed down and polished with steel wool.

<u>Stair Rails from 2nd Floor up Belvedere Floor - Plan G-G:</u> The stairway from the second floor up to the stair head at the door to the vestibule of the Belvedere - Plan G-G shall be fabricated, installed and finished as specified for the lower flight, except that it shall be a single rail on the outer wall only and not double and that it shall be finished by smoothing but not polished.

<u>Area Rails - Plans I-I:</u> These rails around the stair head shall be fabricated, set and finished as specified for the rails of the lower flight, except that there shall be a top and middle rail. Curb connections shall be made as specified for the wall connections.

<u>THRESHOLD</u>:

There shall be cast or extruded bronze threshold set at the front doorway. This shall run the full length of the doorway and the full width of the reveal. The top shall be grooved. It shall be anchored

STEEL SASH & FRAMES

WORK INCLUDED:

This Section shall include the furnishing, setting and finishing of all steel sash and frames as are shown, indicated or noted on the accompanying drawings and/or specified herein.

WORK NOT INCLUDED:

Glazing and finished painting is included in those Sections of thes Specifications.

MATERIAL & QUALIFICATIONS:

General: All steel sash shall be specially made with special attention given to wind stoppage and strength. No particular make is specified herein, except that the sections and fabrication shall be similar and equal to the "Ariston" (Michel & Pfeffer) ~~"Medium Section" and/or "Heavy Section". Sash for windows type L-M-N-P-Q-R-S & T shall be the "Medium Section". Those are small and narrow windows.~~ All ~~other~~ sash shall be the "Heavy Section". The setting legs of all sash section that are embedded in concrete shall be supplemented with 1/4" x 2" spot welded plate run entirely around the frame. All metal, except the bronze fittings, shall be galvanized after fabrication and assembling by the hot dip process. The metal shall then be straightened and all superfluous galvanizing removed. Metal stops or fillet frames screwed in place shall be provided for setting the glass which will be 1/4" thick plate. (Fillet Screws not more than 6" cs.)

Air Infiltration: Air infiltration shall not exceed one cubic foot of air per foot of sash perimeter when subject to a static air pressure equivalent to pressure exerted by wind at a velocity of 25 miles per hour. These requirements must be attained without the use of weather stripping. This formula is the Government Standard and must be attained by the windows used. The Government has tested and certified a number of steel sash manufactures. The window used shall either be

tested by an approved laboratory and a certificate issued therefore, or the window shall have been tested and certified by the Government within the last two years and a copy of that certification presented to the Architect. In any case the make of the window must be approved by the Architect, before the sub-contract is let.

HARDWARE:

All windows shall be fully equipped with heavy plain bronze hardware as is regularly furnished with the standard installation of the "Ariston" heavy section type casement windows. Where casements are single and, without the use of a ladder, cannot be reached for cleaning either from the ground or from a deck, they shall be fitted with extra throw or extension hinges. Locking devices shall work easily and correctly and when locked all casements shall be absolutely locked against the outside.

SETTING:

Metal window frames and sash shall be set in the forms before the concrete is poured. They shall be carefully braced to prevent distortion. After concrete is poured, they shall be put in perfect order and condition, and thoroughly cleaned. The casements shall operate easily and freely and the stay-hardware shall hold any sash in rigid position. All steel sash shall be set and finished by the manufacturer.

ORNAMENTAL TILE & MARBLE

WORK INCLUDED:

This Section of these Specifications shall include the furnishing, setting and finishing of all Ornamental Tile and Marble work as are shown, indicated or noted on the accompanying drawings and/or specified herein.

WORK NOT INCLUDED:

The quarry tile that is laid over membrane waterproofing on roofs and decks exposed to weather and water conditions is included in the Roof Tiling section of these specifications.

MATERIALS:

Previously specified: Certain materials, such as Portland cement, ordinary sand, admixtures, etc., used for tile setting as specified in the Concrete Section of these specifications.

Quarry tiles: Used for interior floors shall be select grade, unglazed, hard burned and dense grained. They shall be free from imperfections, cracks, warps or other defects. The faces shall be out of wind and true and flat. Edges shall be true and straight and the corners accurate. Quarry tile shall be 6" x 12" x 1" with the underside corrugated for anchorage. Color shall be ~~brown~~ red and the run of the kiln, except that imperfectly burned tile, barred faces and light russets shall not be used.

Marble: Marble used for toilet stalls shall be Ozark Gray seamless. It shall be high polished on all exposed faces and edges. Sizes shall be as specified below.

Wall tiling: Wall tiling for lavatory walls shall be white glazed, bright finished standard quality 6" x 6" tile, with special pieces as noted or required.

Floor tiling: Floor tiling for the lavatory floors shall be standard quality, ceramic mosaic tiling, 1" x 2" x 1/4" and in two colors as specified below.

(These were omitted as not being necessary)

Separators: Brass separator strips of an approved pattern and type shall be furnished and set at all places on the ground floor where the finish changes, as between tile and cement, different types of tile, etc. These shall be thoroughly anchored in the concrete fill or to the concrete slab. In general, they shall be set at the center line of the doorway. Where tile work abutts cement work, the two trades shall cooperate and check each other.

CERTIFICATES:

Manufacturers' Certificates certifying the quality of all tile shall be delivered to the Architect before any tile is set.

PRE-SOAKING:

All tile shall be thoroughly soaked at least twenty four hours before setting. All backing, rough slabs, concrete, etc., shall be thoroughly cleaned and washed before tile setting is started.

LAYING QUARRY TILE:

Location: Quarry tile shall be laid over the entire area of the entrance vestibule, the phone alcove, the elevator lobby to the line of the stair door, and the three public spaces ~~of the restaurant~~. This will include the run-ins in doorways and similar places. In such cases the tile shall be stopped on a line under the door against a separator as specified above.

Laying: Quarry tile shall be bedded and set as specified for roof tile in that section. The concrete bedding shall be admixtured only. The tile shall be laid in basket pattern with 1/2" joints. The joints shall be grouted with the white cement and sand and finished slightly below the level of the tile tops leaving the tile edges clean and well defined. The tile shall be carefully cut and shaped against all walls, rising projections and similar conditions.

*Advice of G. M. C. Beam
Beach Engineering Co - Oakland
Formula #20-F.G. - first coat
#19-F. final coat.

Use plain end tile for forming corners.
Joint to leave [illegible] [illegible] [illegible]

Pattern: Before the tile setting is started, the Contractor shall give the Architect an accurate layout of the tile areas drawn to 1/2" scale showing the pattern and location of all joints. This shall be corrected and amended until approved by the Architect.

Finishing: After the tile is set it shall be thoroughly cleaned and touched up where required or necessary. It shall then be given two coats of prepared wax, applied liberally and each coat machine rubbed and the final coat burnished.

Expansion joints: Expansion joints will not be required for interior quarry tile floors.

LAYING CERAMIC MOSAIC TILE:

Location: Black and white vitreous ceramic mosaic tile shall be laid over the entire area of the two toilets up to the line of the brass separator.

Pattern: The pattern shall be basket weave forming alternate 2" squares of black and white. A black border 2" wide shall be laid entirely around the room following the indicated outlines and across the hall door.

Laying: The concrete slab shall be cleaned and washed and then bedded to the required level as specified for the quarry tile. The mosaic tile shall be set in the white cement and sand mixture, brought to the proper planes and levels. Close careful cuts of tile shall be made around all structural and mechanical projections.

Finishing: After the tile is set, the paper back shall be removed and the tile cleaned for inspection. Imperfect tiles or patterns shall be remedied, the tile shall be grouted with the white cement and cleaned and polished with the machine.

SETTING WALL TILING:

Location: All of the walls of the two toilets shall be tiled

from the floor up to approximately 75" high with glazed tile. Where windows enter the tile area, their stools and reveals shall be tiled. Continue the tile around the doors ~~and window~~ as an architrave, returning to the wood.

<u>Pattern:</u> Horizontal joints shall be kept to the level and vertical joints staggered. Use A-3620 type base and 1440 type cap or cove. Corners shall be square. Set a 3" x 6" selected black and white border or insert band at the 11th course up and finish with the 6 x 6" cap pieces.

<u>Setting:</u> Set the tile with the white cement mortar. Joints shall be fine and flush and surfaces flush and even. Point with white cement. Make careful cuts around any mechanical projections.

<u>Finishing:</u> Clean and wash down the tile, do all necessary touching up and leave all tile work in first class order and condition.

<u>TOILET STALLS:</u>

<u>Location:</u> One single stall and one double stall in the toilets where shown.

<u>Description:</u> Marble starts 12" up and runs 60" higher, finishing 72" up. Jambs 1-1/8". Partitions 1". All anchors, dowels, etc. brass or bronze. Marble to be set in advance of wall tiling and <u>after floor tiling.</u> (It will set before the floor tile)

<u>Setting:</u> Marble abutting tile shall enter the tile and shall be blind anchored to the concrete. Chases shall be either poured or cut in the concrete allowing the marble to set in at least 2" and have a full 1" of bedding. Bedding material shall be plaster of Paris and the marble edges shall be fully bedded and not merely pointed in place. The tile shall then be set making tight, flush joints against the marble. The junction of the partition and jamb in the double stall shall be supported on Crane Company metal Standard C-18260. The top shall be braced with C-18224 Standard, C-18234-1-1/8" rail and C-18236

wall flanges. The corner of the single stall shall be supported on C-18262 and the top braced with C-18200, C-18234 rail and C-18236 wall flange. The finish of these metal pieces shall be brush chrome. The floor connections shall be made after the floor tile is set (and shall not done go down to the concrete slab.) The junction of partitions and jambs shall be made with blind metal anchors and reinforced with C-18304 heavy angles applied on the inside.

Hardware: Hardware for stall work will be included in the Hardware Section of these specifications. The setting of any such hardware coming into contact with marble or tile shall be included in this Section.

Accessories: Furnish and mount in each toilet one "Onliwon" metal toilet paper box. In the single toilet it shall be mounted on the tile. In the double stall they shall be mounted back to back on the marble.

TILE BASE:

Run a tile base entirely around the vestibule, phone alcove, lobby and the three sections of the ~~Restaurant~~ Public Space. This shall be the 6" x 12" ~~brown~~ red quarry tile as specified for the floor set on edge. Provisions shall be made in the forms for a 7/8" setback to receive the tile and the tile shall project 1/2" from the surface. This projection shall be varied at the doorways to provide a plinth arrangement. This base shall be set, pointed, finished and waxed as specified for the floor tile.

(1/4" projection O.K. or 3/8")

~~TILE GRILLE:~~

There shall be a tiled grille to connect with the exhaust or recirculation system of the heating plant. It shall be constructed as shown. The perimeter shall be outlined with 3" x 6" ~~brown~~ red tile similar in color, texture and appearance to the floor and base tile. The grille shall be formed with tile set on edge in pattern as shown.

[illegible] ... The corner of the ... shall be supported or ... the top bronze with ... [illegible] ... clamps, ... shall be broken ... The floor ... after the floor tile is set (and shall ... [illegible] ... partitions and grade ... [illegible] ... [illegible]

[illegible] ... shall be ... in the hard- ... [illegible] ... cutting of any such hard- ... in this section.

Fuller furnish & glass-
Types of lit. Belgian- American- etc
& varying in thickness- Control
these in next spec.

[illegible] ... "metal ... [illegible] ... on the tile, ... [illegible] ... or the ... [illegible].

[illegible]:

[illegible] ... vestibule, porch floors, ... the three sections ... This shall be ... quarry tile ... the floor ... edge, provision shall be made in the form ... setting ... the tile and the tile shall project ... surface. This projection shall be varied ... arrangement. This base shall be set, pointed, finished ... as specified for the floor tile.

[illegible]

[illegible] ... to connect with the exhaust or re- circulation system ... it shall be constructed as ... [illegible] ... tile similar ... the floor ... tile. The grille shall be ... in pattern ...

GLASS & GLAZING

WORK INCLUDED:

This Section of the Specifications shall include the furnishing and setting complete of all Glass and Glazing work as is shown, indicated or noted on the accompanying drawings and/or specified herein, and also including all setting of glass and furnishing and setting of mirrors.

~~WORK NOT INCLUDED:~~

~~The glass in the vault lights of the roof over the entrance vestibule is included in another Section of these Specifications.~~

GLASS: X

All glass used in doors or windows shall be plate glass "glazing" quality as defined by U.S. Government Specifications #123. It shall be new, free from scratches, true in plane and highly polished.

SETTING:

In metal: Where glass is set in metal, metal glazing compound shall be used. The glass shall be bedded in the compound and fastened with metal fillets.

In wood: Where glass is set in wood, it shall be bedded with standard glazing putty ~~and set with wood fillets~~.

INSPECTION:

All glass, including mirrors, shall be assembled at the warehouse for inspection by the Architect. After it is set it will be inspected again. Lights found defective shall be removed and replaced with proper glass.

PROTECTION:

After glass is inspected in place, it shall be coated with whiting and protected from injury during the progress of the work. This applies especially to spattering from the cement dash work that is to be applied to the exterior.

CLEANING:

At the completion of the building, all glass, including mirrors shall be cleaned and polished. It will then be given a final inspection and defective or injured glass shall be removed and replaced.

MIRRORS:

Mirrors shall be best quality polished plate. There shall be two mirrors mounted, one in each toilet over the wash basin. These mirrors shall be 30" long and 20" high. They shall be mounted with the long dimension horizontal and the top edge 68" above the floor. Each mirror shall be ground on all four edges. Each mirror shall be bored 1" in at each corner with 1/4" holes. They shall be attached to the tile walls with 1/8" nickle plated toggle bolts. There shall be a leather washer at each bolt between the backs of the mirrors and the tile and a leather washer and a nickle plated washer between the bolt.

W. P. Fuller Co
Glazing Foreman
Mr. Ruef-

Odds & ends of Plate were used and from different factories
In future call for domestic plate

PAINTING WORK

WORK INCLUDED:

This section of the specification shall include the furnishing of all material, labor and appliances required and performing and finishing complete all Painting Work as is shown, indicated or noted on the accompanying drawings and/or specified herein. The term "paint" or "painting" shall include all operations and materials as specified in this section, whether they are done with lead and oil, enamel, lacquer, cement or otherwise.

WORK NOT INCLUDED:

All work connected with the finish painting of the elevator car is included in the Elevator Section. But the doors to the hatchway shall be included in this section.

All metal sash will be delivered and erected without priming. These shall be primed and finished as specified herein.

All of the concrete exterior of the building is finished with cement wash as specified in the Cement Section.

All interior rails to stairs are galvanized as specified in the Miscellaneous Iron Work Section and will be finished under that Section by smoothing and polishing. They will not be painted in any way.

Five exterior doors and their trim are Kalamein covered as specified in the Sheet Metal Section. They shall not be painted in any way.

In the succeeding paragraph (Parts to be Painted) there is listed such parts of the interior and exterior as shall be painted or finished under the Painting Section. Parts not listed therein shall not be painted nor finished in anyway under this Section.

PARTS TO BE PAINTED:

Exterior - All metal sash, all exterior galvanized metal work and railings, front door and bed molds.

Interior - All mill work, doors and trim to three elevator enclosures

concrete walls and ceilings in parts listed by floors, metal facia in elevator shaft and lettering thereon.

Concrete walls & ceilings: The concrete walls and ceilings of the following areas shall be painted.

(a) First floor: Two toilets, phone alcove, lobby, stairway up to 2nd floor, three sections of the ~~Restaurant, Kitchen,~~ Public Space, inner space, janitors closet, ~~furnace and storage room.~~

(b) Second floor: Elevator lobby and west vestibule, keepers room, keepers bathroom, Kitchenette

(c) Belvedere - Plan G-G: Elevator lobby.

(d) Stairway - G-G to H-H.

MATERIALS:

General: All materials shall be the best of their kind and shall be approved by the Architect. Factory mixed or prepared paints shall be used and shall be brought to the building in original packages bearing the seal or label of their manufacturer. These shall not be opened until they have been approved by the Architect. Paints shall be prepare by a manufacturer or reputable standing and those manufactured or produced in San Francisco shall be given the preference.

Turpentine: Turpentine shall be pure spirits. No substitute will be allowed.

Concrete Paints: Material to be applied on concrete walls and ceilings shall be either General Paint Corporation "L & S Cement Paint, Berry Bros., Inc. "Luxeberry" Cement Coating", Medusa Portland Cement Company "Cement Paint" or Pratt & Lamberts "Lyt-all Flowing Flat."
Colors shall be as selected.

Other Paints & Enamels: Brands of other paints, enamels or lacquer shall be as approved by the Architect.

Aluminum Paint: Aluminum paint shall be the General Paint Corporation "Bitulumin" applied and finished exactly as required by their specifications.

WORKMANSHIP:

Preparation: All surfaces that are to be painted shall be thoroughly clean and bone dry. Roughnesses on concrete shall be brushed off with wire brushes.

Application: All paint shall be smoothly applied, the surfaces thoroughly and evenly covered and brought to an even color and finish. Each coat shall be bone dry and hard before the next coat is applied. All ready mixed paints shall be applied exactly as called for by the Manufacturer's Specifications and systems used for the particular material

Preparation of Galvanized Iron: Galvanized iron work shall be thoroughly cleaned and freed from any substance that might affect the adherence of paint. It shall then be freely coated with a solution composed of 1/2 lb. of copper sulphate (Bluestone) dissolved in one gallon of hot water. This shall be allowed to dry on the metal. The metal shall then be given one coat of Hill Hubbel Company (General Paint Corp.) "Galvanized Iron Primer #22 201." It is then "primed" and ready for finishing.

Samples: Samples of all paint work shall be prepared as directed by the Architect and presented to him for his approval. The finished work shall be equal to the approved sample. All colors shall be as selected and approved.

Protection: All surfaces, areas, materials, fittings, equipment, etc., that is not to be painted shall be carefully protected from the paint work. Any such items soiled by the painting shall be thoroughly cleaned and the cleaning approved by the Architect. Special precautions shall be taken when spray work is used. In such case, where the color of the wall is different from that of the ceiling, the wall shall first be done and finished, and then covered with drop cloths.

PAINTING ON METAL:

Galvanized Iron Work: All exterior and interior galvanized iron work, except the stair railing from the 1st floor to Plan H-H, shall be primed as specified and then finished with four coats of aluminum paint. This includes the interior and exterior of all metal sash and frames, all exterior railings at windows, steps, etc., the rail of the exterior stair from H-H to I-I and the well head railing at I-I, and the facia of the elevator shaft. This facia shall be primed as specified and then finished with the cement paint as specified for the stairwells.

Elevator Doors & Trim: This work will be delivered and set with a baked shop coat of primer. It shall be finished with three coat work, using enamel or lacquer. The lobby side of the doors and trim on the 1st floor shall be finished with three coat "Bitulumin" aluminum paint, with simple design in black as selected. The trim will be a different color. The inside of the first floor doors and trim and the rest of the other two doors shall be finished in one color.

Shaft Facia: There will be a metal facia the width of the elevator doorway and running between floors, the entire length of the elevator shaft. This shall be primed and painted as specified for the circular stairs.

Lettering: There shall be three 5" letters in black painted on the metal facia. "B" 24" above the 1st floor door, "M" 24" above the 2nd floor door and "T" 24" below the Belvedere floor.

PAINTING ON WOOD WORK:

General: All wood shall be clean, dry and free from roughnesses, slivers or any coating that might injure the paint. Either enamel, lacquer or lead-oil-varnish coating may be used. The coating shall be opaque and finished flat. Wood shall be primed with the primer suitable to the material and system used and as required by the manufacturer.

All Douglas fir shall be coated with a sealing material to prevent any sap from coming through the paint. After the priming and sealing coat are bone dry, knife putty work shall be done and the wood smoothed down with steel wool or sandpaper. Sandpapering work shall be done between each subsequent coat and the work shall be finished dull, smooth and even colored.

Front Door: The front door and trim, both sides, shall be primed and finished with three coats and finished in two colors. The rails, stiles, cross rails and cross stiles shall be finished with one color and the panels and molds with another. After the color coats are dry and finished, the woodwork shall be given three coats of clear protective varnish or lacquer and left dull.

Screens: The woodwork of the ~~screens and~~ grille doors shall be primed, sealed and finished with three coat work. The finished coat shall be a solid all-over coat. The grille work and plain stripping the doors and panels shall be done in two colors. After the color work is finished, all of the wood shall be given two protective coats of clear lacquer or varnish and left dull. Certain parts of the grille work/on screens and doors shall be finished with three coat "Bitulumin" aluminum paint as directed.

Other Woodwork: All other woodwork shall be primed, sealed and painted three additional coats. The toilet doors, stall doors, vestibule doors, stair-to-lobby doors, ~~phone room to janitor closet, Restaurant to Kitchen doors, vestibule to furnace room doors~~ and trim shall be given two additional protective coats of clear lacquer or varnish and finished dull.

PAINTING ON CONCRETE:

General: While special brands of cement paint are specified for concrete work, the contractor may use a lacquer or an oil-lead-varnish system, but it must be approved by the Architect. Two or more coats

shall be applied. The finish coat shall completely cover the concrete and produce a flat, even, dense tone and an even and uniform color. It shall be without gloss and shall be washable. It may be applied by hand or with spray. Where wainscot or other trim work requires a different color from the adjacent walls, the line of demarkation shall be sharp, accurate and true.

Vestibule
Elevator Lobby
Three sections of the ~~Restaurant.~~ Public Space

The walls of these areas shall be finished in six shades of the same color applied in vertical strips about 12" wide and as directed. The line of demarkation between the shades shall be sharp and accurate and each shade shall be allowed to dry and set before the adjacent shade is applied to prevent running and blending of shades. The ceilings and beams shall be finished with one of the lighter shades or a variant of it, to a solid color.

Phone Room:
Stair from 1st to 2nd Floor
Elevator Lobby & Vestibule - 2nd Floor
Elevator Lobby, Belvedere Floor - Plan G-G
Stair from G-G to H-H

These parts shall be finished with one color on the walls and a lighter color on the ceilings, soffits, etc.

~~Kitchen~~ Inner Space
~~Store Room~~
Janitors Room
~~Furnace Room~~
Two Toilets
Janitors Apartment & Bath

These parts shall be finished with one color on walls and ceilings.

DIRECTIVE WORK:

Where special directive work on grilles, grille doors, elevator doors and the striped work on the ~~restaurant~~ Public Space, vestibule and lobby walls are specified to be "as directed", the general scheme is subject to change or variation, provided that the change or variation does not cause

extra expense to the Contractor. In which case, the change will be either modified or the extra expense compensated for.

PLUMBING WORK

WORK INCLUDED:

This Section of the Specifications shall include the furnishing, setting and finishing of all Plumbing Work as is shown, indicated or noted on the accompanying drawings and/or specified herein. This shall include all plumbing, sewers, gas fitting and other items as shown and/or specified.

ALTERNATE MANUFACTURER:

The following specifications are written to provide for material manufactured by companies as listed in the specification. The Contractor may submit alternate proposals and alternate prices for the material of other manufacturers as provided in the Section of General Conditions and Data of these Specifications.

PERMITS, RULES, ETC:

The Contractor shall obtain all permits and pay all fees required for the complete installation of the work. He shall follow all City of San Francisco Rules and Regulations and also rules of local Gas & Water Company in the installation of the work.

MATERIALS:

All materials shall be new and the best of their respective kinds.

Soil, sewer and waste piping shall be cast iron asphaltum dipped.

Fittings for soil, waste and sewer pipe shall be cast iron, asphaltum dipped.

Vent pipe shall be cast iron or Byers genuine wrought iron galvanized, with cast iron or malleable galvanized iron fittings.

Cold water pipes shall be National Tube Company mild steel galvanized. Hot water shall be the same as specified for cold water.

Fittings for hot and cold water shall be malleable iron galvanized and banded.

Gas piping shall be National Tube Company mild black steel with black malleable iron banded fittings.

Downspout and drain lines shall be cast iron extra heavy asphaltum dipped.

Unions shall be ground joint, brass-to-iron, galvanized.

Valves shall be Crane Company all-brass gate valve #437 (or approved equal) for sizes 2-1/2" and smaller and #462 for sizes 3" and larger.

SEWER:

Make connection to sewer at point shown and do all excavating, back filling and removing of surplus earth required for running sewer in ground from street connection to the building.

Sewer shall be at least 18" below grade.

All joints shall be leaded and caulked.

SOIL AND WASTE PIPING:

Every plumbing fixture, roof or floor drain shall be properly connected to soil or waste system.

The lines shall be of sizes indicated and run generally as shown.

SLEEVES:

The Contractor shall install metal sleeves in concrete forms before concrete is poured and where pipes pass through concrete walls or floors.

COLD WATER PIPING:

A booster pump shall be located on the property where shown, and connection shall be made to street line and run to pump. The pump shall discharge into two of the four house tanks located in the building - Plan E-E. The house tanks shall supply all fixtures, hose ranks, bibbs, and irrigating system with water.

PUMP AND MOTOR:

Furnish set-up on concrete base 12" high an American Steam Pump Company centrifugal pump direct connected to a 5 H.P. General Electric Co., 1760 R.P.M. 3 phase, 220 volt, 60 cycle, alternating current motor.

Pump shall have double suction, split case, bronze fittings and impeller.

Both pump and motor shall be mounted on a heavy cast iron base which will be anchored to concrete base.

Pump shall have a capacity of 75 gallons per minute when operating against a head of 95 feet. Pump shall be of the H.B.M. type with 1-1/2" discharge and 2" suction.

BASE:

Make concrete base 12" high with bevelled edges, and install 3/4" anchor bolts in proper location.

Concrete shall be 1;2;4 mix equal to concrete used in building construction. Grout in cast iron base of pump and motor.

The electric wiring sub-contractor will furnish switches and do all wiring required for connecting motor.

PUMP SUCTION AND DISCHARGE:

Bring 3" suction to pump, reducing at pump flange. From discharge side, run a 3" line underground to building and extend to tank location, discharging into two tanks #1 & 2. Install valves on suction and discharge side of pump in pumphouse and also on each branch to house tanks #1 & 2. Underground pipe shall be 18" below grade.

HOUSE TANKS:

Furnish set-up and connect where shown, 4 house tanks. Each tank shall be 3'6" wide, 6'9" long and 8'0" high made of 5/16" steel plate, with welded seams. The 6'9" sides and bottom shall be made with one sheet of steel and with edges flanged 1" to receive the two other 3'6" sides. The seams shall be welded on inside and outside. The tank shall be stiffened as shown with ~~three~~ 3" 5.7# I beams spot welded to tank and to each other at corners.

The top edge of tank shall be equipped with 3" x 3" x 1/4" angle to which shall be welded a top made of 3/16" steel plate stiffened by 2" x 2" x 1/4" angles spaced 18" on centers running at right angles to the 7'0" side of tank. In top, provide a hinged access door of size shown.

Tanks Nos 1 & 2 shall be provided with 5" coupling welded to tank near top for overflow connection. Each tank shall be provided with a 4" couling welded to bottom of tank. Each tank shall be provided with a pan 4'1" wide, 7'7" long and 4" high made of 3/16" steel plate with welded seams and joints. In bottom of each pan weld at proper point a 6" pipe nipple 3" long through which the 4" house supply connection will pass.

Weld a 2" coupling to the bottom of each pan for drain connection. Provide three 6" I beams for each tank. These I beams shall rest on the pan and support the tank. The pans shall rest on two 12" x 12"x 3'6" concrete bases located as shown. Concrete bases shall be made with1-2-4 mix and pan shall be grouted in place. Tanks and pan shall be painted in the field. The inside of all tanks shall be painted with one priming coat of Biturine and two caots of Biturine enamel. The outside of all tanks, the pans and the I beams shall be painted with two coats of Biturine.

TANK CONNECTIONS:

Tanks Nos 1 & 2 shall be provided with overflow piping with drain connection from each tank and pan run as indicated and discharging on roof over Keepers Room/ The tanks shall be drained by a valved 2" connection to 4" supply to equalizer as indicated. The 4" overflow main shall be run below tank floor and hung from same. Install all-brass horizontal check valves in drain from each tank-pan.

The supplies t the equalizers shall be taken off the bottom of each tank with connections made as shown. The equalizer shall be run above tank floor. A 3" line shall be connected to the equalizer with valve and this line shall drop to ground, capping same 18" below grade. This line shall be used for irrigating system to be installed under another contract A 2" valved connection shall be made to equalizer which will supply all fixtures, hose bibbs, water heater, etc., A 2" valved line shall be run from equalizer to hose rack location.

SUPPLY TO FIXTURES:-

Each plumbing fixture, hosebibb, water heater, etc., shall be supplied with cold water of sizes specified, shown or required. A capped 3/4" cold water pipe shall be extended to the location of the Drinking Fountain provided for in Alternate No 5.

HOSE BIBBS:-

Install Mueller, all-brass, rough finished, loose key hose bibbs where shown. Bibbs shall have integral wall flanges and key shield.

HOT WATER SYSTEM:-

Furnish and set in place where marked in the Kitchenette a WESIX Catalog No 20 C O P electric heater and tank. Tank and heater shall be completely connected and ready for use. The tank shall be made of copper insulated with cork and finished with a metal jacket. Heater shall be 5 KW capacity, 220 volts. Tank shall be connected to valved cold water supply, and hot water supply connection to be made to sink, bath tub and bath tub in the Keepers Quarters and t the slop sink in the Janitors room of the first floor, Run concealed hot and cold water piping behind concrete walls and above ceiling. All hotwater piping shall be insulated with 85% magnesia pipe covering banded and fittings insulated with plastic asbestos finished with canvas. Electric connections shall be made complete by the Electrician.

KITCHEN CONNECTIONS:- There will be no kitchen equipment furnished or installed, but there shall be a 2" waste and vent connection, capped, and a 3/4" cold connection run to the Inner space of the First floor where shown.

FLOOR & ROOF DRAINS:-

All fl or and roof drains shall be connected to the sanitary sewer. They shall be located where marked and the connections run as sho In the Innerspace, first floor, use Josam # 353 without clamps, and polishe brass strainer. All roof drains shown on Plans C-C, D-D, H-H and I-I shal

be Josam #433-B-S with clamping ring and dome strainer. The drain at the foot of the stairs on Plan HH willhave to be set in the corner or a spec- ial dome strainer provided that will be low enough to clear the door.

COMBINATION FLOOD LIGHT ENCLOSURE & DRAIN:

Plan G-G shows the location of eight flood light enclosures. This contractor shall furnish these enclosures, set them in place and connect them to the drainage system. These enclosures shall be made as shown in in the detail. Seams and joints may be welded with 2" drain connection in bottom. The top of the enclosure shall be provided with a polished plate glass one inch thick set in a galvanized iron frame with elastic cement.

CLEANOUTS:-

Install cleanouts with heavy brass plug and ferrule at points shown o or directed by the Architect.

VENTS:-

The vents from plumbing fixtures shall be run to points shown and extended to roof over Keepers Quarters. All fixtures shall be vented.

HOSE RACK:-

Furnish and connect complete a Lightning Hose Rack with 75'0" of Underwriters 1-1/2" unlined linen hose, vozzel and valve complete. Place where shown.

THE SCHEDULE OF PLUMBING FIXTURES

GENERAL NOTE:

Furnish, set and finish complete, with all necessary or required accessories and fittings, the Finished Plumbing Fixtures as listed below. All fixtures attached or hing to concrete shall be hung with bolts and expansion shields. All hot and cold supplies to fixtures shall be con- trolled at the fixture with compression valves a at the fixture. All ex- posed piping in the two toilets on the first floor shall be chromium plat ed, brush finish. All fixture fittings in the two toilets and the Keep-

quarters shall be chromium plated, brush finsihed. Hose cocks shall be rough brass. Other fittings shall be finished brass,

THEFITTING ON FIRST FLOOR

Womens Toilet

LAVATORY: (one)

Crane Co C-405-Corwith, 20 X 18, vitreous china wall hung lavatory with open strainer. C-31970 Self closing cold supply faucet. Metal closing plate on other hole. 1/2" OD annealed tubing supply with loose key stop, 1-1/2" C-33900 cast brass P trap, less plug, with cleanout.

WATERCLOSETS (Two)

Crane Co C-10570 "Santon" vitreous china, full syphon jet, with 10" x 15" elongated rim. C-13022mA Crane Co water controlled flush valve and stop. # 119-C Church seat, sani-black, open front seat less cover, with check hinge, closet screws, washers and china caps.

Mens Toilet Room:-

WATER CLOSET (One)

Same as specified for Womens Toilet room

URINAL (One)

Crane Co C-15644 "Vorto" vitreous china, syphon jet, pedistal urinal. C-13958 Crane Urinal water controlled flush valve and stop, closet screws washers and china bolt caps.

LAVATORY (One)

Sameas specified for Womens Toilet.

JAnitor's Closet:-

SLOP SINK (One).

Crane Co -C-21360-0, 24 X 20, Enameled iron rool rim slop sink on cast iron trap standard, no drilling. C-21500 rim guard, 1/2" C-31362 sink faucets, on hot connection and 1/2" C-31363 hose spout on cold connect ion.

SECOND FLOOR

Keepers Bathroom

TOILET: (One)

Same as specified for the first floor toilets.

LAVATORY:- (One)

Same as specified for the first floor toilets, except H & C supply.

BATH TUB: (One)

Crane Co - C-3442-D60 "Doris"-5'0", enameled, acid resisting roll rim tub, on base. C- 33103 compression double faucet with four arm metal handles, 1/2" bath supplies with straight stops and floor flanges No 1100 connected waste and overflow with chain and rubber stopper.

Keepers Kitchenette.

SINK: (One) This was changed to flat rim kitchen sink & drain

20" x 30" enameled iron, acid resisting roll rim with 12" back Fit with 1-1/2" P trap and Crane "Agilis" double sink faucet, swing spout

(Note: The plumbing supply and vents in these two rooms may be run exposed, with chromimum plated floor and ceing flanges.

****************** ****************** *********************

(3" No 115 = Merco-Nordstrom. Flanged & faced and drilled - semi-steel - with screws.)

GAS FITTING:-

The P G & E Co will install a meter under the West Terrace and connect to their main. This contractro shall connect at the meter and run a 3" wrought steel galvanized pipe under ground from the meter to the building and thence up through the elevator shaft, closely placed innone cornere there of and as directed, and thence up to the floor of the lantern room about elevation 435'#3" CB. Install in first story where marked a 3" Merco-Nordstrom positive cut-off valve about 5'0" above the floor legel. Take a 1/2" pilot pipe line off the pipe below the shutoff valve. Place an approved 1/2" shutoff cock on hte pilot light line and run the pilot line adjacent to themain line up to the

lantern floor level. The main and the pilot lines shall come out at the center of the floor and finish 6" up with threaded end capped and ready for future connection. Furnish and set in the lantern room floor a Shand & Jurs No 144 sanitary fitting without the double drainage feature The 3" main shall be run through this fitting and made watertight. The 1/2" pilot light line shall be run through the concrete slab and made watertight as directed and then taken oger to the 3" main.

METER ROOM:-

A meter room shall be formed under the slab of the west terace. This shall be large enough to take the gas meter. Its walls shall be formed with ~~mmmmm~~ concrete. The floor shall be left open for drainage. The top over the meter must be waterproof. The opening shall be fitted with an angle iron frame/ galvanized/ ~~and~~ a 3/16" reinforced sheet of galvanized iorn as a door with necessary hinges and loc~~x~~ing ing device for a pad lock/ This meter room shall conform to the requirements of the P G & E Co.

Changed to copper per recommendation by [illegible].

ELECTRIC WORK

WORK INCLUDED:

This section shall include the furnishing, installing and finishing of all Electric Work as is shown, indicated or noted on the accompanying drawings and/or specified herein. This includes wiring and conduit work for light and power systems and all accessories connected therewith, all lighting fixtures, flood lights and their lamps, together with all required connections as shown or specified.

ALTERNATE MANUFACTURE:

The following specifications are written to provide for material manufactured by the companies whose material is mentioned. The Contractor may submit alternate proposals and alternate prices for material made by other companies as provided in the Section of General Conditions and Data of these Specifications.

RULES AND REGULATIONS:

All local rules and regulations of the City and County of San Francisco shall be followed in the installation of the work. Pay all fees and obtain permits and certificates.

SCOPE OF WORK:

The Contractor shall run underground four wire service from transformers on pole on Filbert Street to the switchboard in second story, from which point 3 phase, 220 volt current shall be distributed for power and 110/220 volt single phase current shall be distributed for light and heat. Flood lighting of the building shall be installed complete with flood lights and enclosures. Lighting fixtures shall be furnished and installed. Telephone conduit shall be installed and a signal system will be provided. All of the above work and material shall be included in this Section.

WORK NOT INCLUDED:

Telephone wiring will be done by the P.T. & T. Company.

SERVICE:

Run service wires underground of size shown from the P.G. & E. Company transformers to service switch located in heater room. Do all excavating, rock cutting, backfilling, repairing of highway and removing of surplus earth required for the installation of this service. Service wires shall be run in rigid conduit, galvanized or sherardized, with top of conduit at least 18" below grade. Service shall be 60 cycle, 120-208 volt AC with solid neutral. The service switch shall be Trumbull, Square D, Westinghouse or Cutler Hammer externally operated and securely mounted on ~~wall~~ main switch board

SWITCHBOARD: 2-19-51

In second story where shown furnish, install and connect a "Switch fus" safety type, totally enclosed switchboard. The switchboard shall be of Frank Adam Electric Company manufacture or Diamond Electric-Type PK-"saflex". All live parts shall be totally enclosed, both front and rear, in a #10 gauge steel wire enclosure. The switchboard shall be furnished with the number and capacity of main and branch feeder switches for light and power as listed in the schedule or riser diagram, which forms a part of this Specification. The switches shall be of the double break, externally operated, fusible, safety type, with indicators showing "off" or "On". Position switches shall be operated by means of doors in individual cover plates. Fuses shall be located on an insulating base on inside of door, which shall be hinged at bottom. Switch contacts shall be mounted on bases of ebonized asbestos. Provide cardholder and typewritten card for each switch to indicate circuit controlled. Detail drawings to a scale of 1-1/2" = 1'0" shall be submitted for approval before beginning construction. Space shall be provided for meters, and other P.G.&E Company equipment as required.

PANELBOARDS AND CABINETS:

Shall be Frank Adam "Standardized Safety Type" N.T.P. or Diamond Electric located

where shown. Panels shall be provided with bus bar fuse receptacles, etc. with no live part exposed. Panels shall have three wire mains and two wire branch circuits unless otherwise specified. All branches to have single fusing, solid neutral connections. Each circuit shall be provided with card holder and typewritten card. Provide each switch with plug type fuse receptacle. Enclose the panel boards in galvanized iron cabinets with 3" wiring gutter, hinged door complete with lock and two keys. Panels A and B and A-F will bte the N E P type. Panels A, A-F & B shall be the same type but located on the main switch board. Panels BF, CF, DF and EF shall be mounted on the same cabinet located in the elevator machine room and each shall be controlled by a Frank Adams 100 Amp. two pole, mechanically held, remote controlled switch mounted in same cabinet. Run nine or more No 14 wires in 1" conduit from the panels AF, BF, CF, DF and EF to a five gang plate Cutler Hammer momentary contact switches located adjacent to panel AF in Keepers Quarters, to control the remote controlled switches.

CONDUIT:-

All wire shall be run in rigid conduit, using Greenfieldduct or approved equal. The conduit shall be runconcealed in the public spaces and on Plans GG and II. The conduit may be exposed in the inner spaces and parts behind the radial fins in the tower. The contractor shall not run conduit in bearing walls unless authorized to do so by the Architect. When conduit is run exposed, it shall be firmly clamped to the building construction.

OUTLET BOXES:-

On exposed work, outlet boxes shall be fot conduit type. Where run in concrete the boxes shall be Sprague or equal as apporved. All switche for control of lighting outlets shall be equipped with standard type boxew Outlet boxes exposed to the weather shall be weather proof.

WIRE:-

All wire used for light, heat and power shall be G E Company,

Habirshaw or Simplex rubber covered wire made in accordance with latest N.E. Code. All wire shall be new when delivered on job and year of manufacture, etc., shall be marked on the package. This date shall not be more than six months previous to time of delivery on job. Branch lighting circuits and convenience outlet circuits shall be #12 gauge. All joints and splices shall be insulated with two thicknesses of Oakonite or approved equal and approved gum with two layers of approved tape. Paint tape one coat of P & B paint.

LOCAL SWITCHES:

All ceiling and bracket outlets shall be controlled by local switches, single pole or 3 way as required. Switches shall be of the tumbler type in restaurant room and kitchen and shall be G.E.Company #1694 or H & H #1611, 10 ampere capacity. Switches in public spaces, spiral stairway in Belvedere, etc., shall be Bryant type B composition cup switches of the lock type Bryant #601L or 603L.

CONVENIENCE OUTLETS:

Shall be Bryant #120 or 122 flush receptacle with Cadmium plated covers.

SWITCH PLATES:

Shall be made of brass, .06" thick and electro plated dark bronze finish.

ELEVATOR CAR LIGHTS:

Install outlet in center of hatch where directed for lighting elevator car.

ELEVATOR MOTOR:

Install switch in elevator machine room where shown and connect to switchboard.

FLOAT SWITCH:

Furnish and install in house tank #2. A Cutler-Hammer enclosed float switch, complete with bracket, float guide, etc., and Cutler-

Hammer high-water alarm. The float switch shall control a 5 H.P., 220 volt, 3 phase, motor driven, centrifugal pump in pumphouse shown on plot plan. The float switch shall be firmly secured to steel tank and all work required in connection with wiring of motor shall be done by this contractor. The relay panel shall be located in switchboard room.

MOTOR STARTER:

The motor starter for house pump shall be located in switchboard room and shall be Cutler-Hammer #9586-H-621 for 5 H.P., 3 phase 60 cycle, 220 volt motor.

MOTOR SWITCH:

Install an externally operated switch in pumphouse to disconnect the 5 H.P. motor.

MOTOR CONNECTIONS:

From pumphouse to switchboard room run lead covered wire installed in rigid conduit connecting starter with motor. Conduit shall be made watertight and shall be not less than 18" below grade. Remove surplus earth.

~~FAN CONTROL:~~

~~Furnish and install a Cutler-Hammer enclosed automatic motor starter for 1/2 H.P., 220 volt, 3 phase furnace fan motor. Locate near motor.~~

~~PROPELLER FAN CONNECTION:~~

~~A 16" propeller fan will be installed in the future at ceiling in kitchen alcove connected to ventilator. This Contractor shall run a circuit from panel and install a 30 amp. switch and conduit connection to fan location complete with all wiring.~~

LIGHTING FIXTURES:

Every light outlet in building shall be provided with lighting fixture socket, etc. This Contractor shall allow in his proposal the sum of ~~$600.00~~ $400.00 for furnishing, setting and finishing all lighting fixtures and lamps in building. The manufacturer and the fixtures will

be selected bybthe Architect. This figure does not include flood lights or other fixtures or their lamps called for and herein specified.

LAMPS:-

Every outlet shall be equippped with a Mazda type lamp of wattage specified or required. All lamps shall be furnished by the Contractor.

FLOOD LIGHTING:-

As herein before stated, the buildingnshall be flood lighted by five sets of flood lights A,B,C,D and E. Lights A consist of 20-1000 watt units located in steel enclosures fastened to parapet walls and roof over the Keepers room. Lights B consist of 8-1000 watt units located under floor of belvedere in steel enclosures with glass tops whaich will be furnished an installed as specified in the Plumbing Section. Lights C consist of 16-200 watt lamps units set on sills where shown. In Plan II, flood light D shall be bolted to concrete walls 6'0" above the floor? Install three Grinnell concrete inserts in the walls for each unit. Outlet E shallbe a Aprague and shall be set in the floor where shown. All of the above banks of lights shall be remotely controlled from location adjacent to panel AF in Keepers Room, with a separate control for each bank. Ten three wire circuits shall be run from panel AF to flood lights marked A. Four 3 wire circuits shall be run from panel BF to flood lights marked B. Two three wire circuits shall be run from Panel C to flood lights marked C. Four threewire circuits shall be run from Panel D to outlets marked D. One three wirecircuit shall be run from panel E to outlet marked E.

UNITS:*

Units A shal be G E Company type AL-31-C flood lighting projectors complete with stippled amber lense. These projectors shall be connected to outlet in parapet wall and inclosed in hinged steel boxes.

Unit B shall be G E Co. type A L 31C projectors with stippled amber lens set in steel boxes included in the Plumbing Section.

Units C & D shall be G E Co. A L 31C projectors.

Unit E shall not be included in this Contract.

All of the above units shall be firmly bolted to the concrete walls or the decks or in the steel enclosures. Lamps for units A B and D shall be 1000 watt PS-52 General Service type. Lamps for units C shall be 200 watt- PS-40 general service mazda type; All lamps of 100 watt or under sha be the mazda type, inner frosted- whether they are inclosed or exposed.

PITT LIGHTING FIXTURES:-

Furnish and set in concrete walls before the concrete is poured, Benjamin # 5715 pit lighting fixtures complete with 150 watt lamps, socket etc. Six units shall be installed where shown in Plan CO. Face of metal shall be flush woth the face of the finished wall.

FLOOD LIGHT A ENCLOSURES:- (Replaced by wire enclosures)

Furnish and set in place on parapet walls where shown for each of the 18 "A"units,a steel enclosure made of 3/16" steel plate having inside dimensions of 21" length,18" depth and 21" width. Boxes shall be made with angle iron frames welded at the corners. Weld the 3/16" iron plate to the angles. Angles shall be 1-1/2" x 1-1/2" x 1/4". The top and front side s shall be hinged where shown which,when closed shall lock with a snap Yale lock with key. Install three Grinnell concrete inserts in th parapet walls for 1/2" bolts and box shall be bolted to these inserts with bolts on the inside of the box. There shall be no back plate, but the top and bottom shall be shaped to conform to the curvature of the parapet wall. After boxes have been completed they shall be galvanized by the hot dip process. The enclosure shall be so set that the axis shal be radial with the center of the tower. Submit shop drawings for approval before starting work on the boxes. The units shall be housed in these enclosures and they shall be substantially secured to the parapet walls. The two "A" flood lights on the roof of the Keepers Quarters shall be installed in place without enclosures.

WATER HEATER CONNECTION:-

Run a 220 volt, two wire circuit with No 10 wire to # 5 K W water

heater with 30 amp. disconnect switch at heater location. Heater shall be furnished and installed under the Plumbing section, but all electrical connection work shall be included in this Electrical section.

RANGE CONNECTIONS-

Run a 220 volt, two wire circuit with No 10 wires to the Kitchenette in the second floor and to the Innerspace on the first floor. Furnish wit 30 amp. Disconnect switch.

FUTURE HEATING PANEL:-

Install complete a 60 amp. switch on main switch board and a 1-1/4" conduit from switch board to point shown on first floor. Cap the conduit 6" above the floor and mark the same with letters stamped on the cap. The wiring shall not be run.

STAIR LIGHTING:-

Lighting outlets on the stairs shall be continued at approximate intervals as indicated on Plan GG throughout all segmen s of the the tower so that there shall,be at least one light at each half turn of the stairs.

TELEPHONES:-

Install a 1" conduit at nearest telephone service pole and run under ground to terminal box underneath the stairs in the Inner space-First floor. From this point run 3/4" conduit to telephone station in First floor and Keepers Quarters where marked. All of the work shall be done as required by the Telephone co. Finish with outlet boxes located as required.

TESTING:-

The entire wiring system shall be tested for grounds, etc., to demonstrate that outlets are connected to proper circuits as called for or shown. The flood lights shall be adjusted to flood the exterior of the building as required by the Architect;

BELL:

Furnish and install complete a push button call bell from the front

door to the elevator shaft at the Belvedere floor and with extension to the vestibule of the keepers quarters. The push button shall be cast bronze to match the front door handle plate and shall be installed 72" above the floor sill at the left of the front door. Wiring shall be run in conduit to the shaft and to the keepres vestibule. The shaft bell shall be a 4" gong and the Keepers bell a 3" gong. The bells shal operate on a Dongan transformer connected with the lighting system.

GUARANTEE:

The contractro shall guarantee all work amd materials to be free fr from defects and he shall repair or replace at his own cost any defects which may develop within one year from the accpetance of the work.

ALTERNATES NOS 1 & 4:-

The following electrical work shall apply to Alyernates 1&4. Section No 23. Alternates.

Run conduits for future lighting outlets on the terraces. on Circuit 7-A to 11-A. inclusive. These conduits shall be run to the outside of the modified terrace wall, capped and the number of the circuit stamped on the metal of the cap. Spare switches shall be left on Panel A for these future circuits. The ends of the wires at the outlets shall be taped and coiled back.

HARDWARE

WORK INCLUDED:

This Section of the Specifications shall include the furnishing, setting and finishing of all Finished Hardware as is required by the conditions shown, indicated or noted on the accompanying drawings and/or specified herein. This is intended to include all Finished Hardware required to complete the entire job, except the hardware on the metal sash and elevator hardware, both of which will be included under separate sections of these Specifications.

The following items shall be included in the term "Finished Hardware"; All door trim, including butts, locks, bolts, catches, stops and holders, push plates, pulls, etc.

All door transom fittings, including adjusters, butts, etc.

All stall door fittings including latches, hinges, bumpers, hooks etc.

All cupboard and case hardware, hinges, catches, stops, etc.

ACCESSORIES:

All screws, bolts and other small parts necessary to complete the installation shall be furnished with the order.

MATERIALS:

The Specification is written for the furnishing of Corbin locks, Corbin door checks, Stanley butts and Rixon floor hinges. Russel & Erwin Company or Schlage locks may be substituted for the Corbin locks, provided the substitution is in every respect equal to the specified lock. Russel & Erwin, Norton or L C N door checks may be substituted for the Corbin checks. No substitution will be considered for the Stanley butts or the Rixon floor hinges.

Strikes for all doors other than cabinet and stall doors shall be full box strikes.

Butts for exterior doors shall be solid bronze. Butts for interior

Knobs shall be 2-1/4" cast, mounted on roses and fitted to screw less type spindles adjusted with spanner wrench.

Backsets for doors shall be gaged to set at the center of the stile.

Push and pull plates which require cutting for admission of cylinders or keys shall be cut accordingly. Push plates shall be cut at the bottom.

Trim shall be plain type without moldings or ornaments.

Finish for the lavatories shall be brush chrome plate on brass. The balance of the finish shall be bronze (Stanley A-4) and unlacquered.

KEY WORK:

Cylinder and bit key locks shall be keyed different and master-keyed. Three master keys of each shall be furnished.

SERVICE:

All hardware shall be assembled, sorted and marked at the warehouse and delivered to the building (or to such trades as required) with duplicate shipping tags. The hardware sub-contractor shall co-operate with the Contractor and with trades applying hardware. He shall provide cutting templates. He shall provide for and make all necessary exchanges, substitutions, etc.

SUB-CONTRACT TIME:

The sub-contract for Finished Hardware shall be let within thirty days after the date of the General Contract and all deliveries shall be completed within ninety days from that time.

MANUFACTURE:

All hardware shall be factory made and assembled. No locally made or assembled goods shall be used. In this case, the Schlage Lock Works are considered as "Factory made and assembled".

HARDWARE SCHEDULE

FIRST FLOOR

One pair Entrance Doors:

1 Set of locks	H B	1386 x 778-84 6x6
3 Pair Butts	H B	280 x 5" x 5"-Ball bearing
2 Flush bolts	H B	2859-1/4" x 71 strike
2 Door stops	H B	~~0370-1/2~~ c369/2
1 Door closer		Type 104.

Two doors to Toilet Rooms:-

2 Locksets	H B	149-1/4
3 ~~2~~ Pair butts	DCR	280 x 4-1/2-4-1/2
2 Push Plates	H B	780-90 x 4 x 16
2 Pulls	DCR	4396
2 Door closers		Type#3

Three Stall Doors:-

3 Sets Pivots	C I	4227-M Dull chrome
3 Strikes		1247-F Dull Chrome
3 Bolts	DCR	156-1/4
3 Hooks	DCR	2422

One Door-Vest to Inner space (cut)

1 Pair butts	R	239-A 4-1/2 x 4-1/2
1 Lock set	H B	780-272-P H
1 Stop	H B	365

One door- Inner space from Janitors Clos: (cut)

1 Pair butts	R	239-A 4-1/2 x 4-1/2
1 Lock set	H B	740-272- P H
1 Stop	H B	365

Three Double Acting Doors- Public inner spaces:-

3 sets floor hinges	H B	# 30 Rixson
~~3 Push Plates~~	H B	~~780-90- #4 x 16~~
6 ~~3~~ Push Plates	H B	2340 x 4 x 16
3 Lock sets	H B	149-1/4
3 Kick Plates	H B	# 14 ga. bronze- 11 x 32
3 Kick plates		# 14 fur. steel- 11 x 32

ONE Pair doors from Stairs to Lobby :-
One pair of Doors from Elevator Lobby to Vestibule:-

6 Pair butts	H B	239-A 4-1/2 x 4-1/2 Ball Bear
4 Flush bolts	H B	2859-1/4
2 Sets locks	H B	149-1/4
2 Door closers		Type 103 # 3
2 Check brackets		26 x 3
4 Door holders	H B	370-1/2
4 Kick Plates	H B	No 14 Gage bronze 11 x 22
4 Push Plates	H B	780-90 4 x 16
4 Pull plates	H B	780-88 4 x 16

(Rewritten)

SECOND FLOOR

Two Dooss- Vestibule tomRoof-Kalamein copper covered:-

3 pair butts	H B	280- 5 x 5- Ball bearing
2 Door closers		Type 104
2 Check Brackets		26 x 4
2 Pulls	H B	780-88
2 Locks	H B	149-1/4 T P outside

Two doors to Janitors Quarters:-

2 Pair butts	H B	239-A 4-1/2 x 4-1/2
2 Locksets	H B	780-272 P H
2 Stops	H B	365
1 Latch (outer door)	H B	356

Two doors- Keepers Bath & Kitchenette:-

2 Pair butts	H B	239-A 4-1/2 x 4-1/2
2 Lock sets	H B	780-272-PH
2 Stops	H B	365

One Door- Stair to Vestibule:-

1 Pair butts	H B	239-A 4-1/2 x 4-1/2
1 Lock set	H B	149-1/4 T P on stair side
1 Push Plate	H B	780-90 4 x 16
1 Pull	H B	780-88 4 x 16
1 Door closer		Type 3

FLOORS D D F F- H H.

One Door to Tank Space:- Plan DD
Two Doors to Tank Room:- Plan FF
One Door to Machine Room:- Paln HH

4 pair butts	H B	241-A-4 4-1/2 x 4-1/2
4 Lock Sets	H B	780-272 P H

FLOORS G G & H H

One Door- Vestibule to Deck:-
One door- Vesttibule to Outer stair:-

Same as Doors -Vestibule to roof- Second Floor-

Two Doors- Stair to Vest. & Vest to Stairs:-

Same as Door- Stair to Vest- 1st Floor- T P on stair & Vest.

2nd

PUMP HOUSE

One door- Pump house to Drive- Kalamein- Galvanized iron:-

1 Pair Butts	H B	275 4 x 4
1 Latch	H B	356
1 Pull	H B	4396

GRILLES ON DOORS
First Floor

One door pair from Stair to Elevator Lobby:-
One door pair from Elevator Lobby to Vestibule:-

One each door of each pair there are two swinging grilles

Over each door of each pair there are two swinging transom grilles

16 Pair butts	P- 285 2-1/2 x 2
20 Catches	Use Part A- spring bolt- of Corbin Cabinet Lock "Pasquil" Desk lock 790

MISCELLANEOUS

Three Master Keys to pass all bitt keyed locks

Three Master Keys to pass all cylinder locks

One Tel-Key key cabinet No 101- 30 hooks- Finish French Gray. Mount on wall of vestibule to Keepers Quarters- Second Floor

Four dozen Tel Key Fiber Markers - Color Gray.

ELEVATOR WORK

WORK INCLUDED:

This Section shall include the manufacture, installation and finishing complete of all Elevator work as is shown, indicated or noted on the accompanying drawing and/or specified herein. This includes the furnishing and erection complete by the Otis Elevator Company of one Otis passenger elevator together with machine, motor, controller, safety devices, ornamental car complete with car gate, platform, guides, sheaves and sheave beams, cables, dial system, hatchway entrances complete with doors, door hangers, interlocks, and all other apparatus, material or work required to make the elevator complete and operative when electric current is supplied to the controller.

ALTERNATE MANUFACTURE:

The following specifications are written to provide for the manufacture, installation and finishing complete of all Elevator Work as herein specified by the Otis Elevator Co. The Contractor may submit an alternate proposal and alternate prices for the work of an other manufacturer as provided in the Section of General Data of these Specifications.

WORK NOT INCLUDED:

The following work is not included in this Section, but is included in other Sections of these Specifications;

1. Preparation of proper and legal frames and enclosed hatchway and pit.

2. Proper supports for guide brackets, buffers and overhead sheave and machine beams.

3. Machine room and penthouse complete with concrete floor.

4. Light outlet at the center of the hatchway.

5. Feeder wiring to the terminals of the elevator controller with the necessary feeder switches, fuses, circuit breakers, and any other equipment required by local regulations.

6. All current necessary for testing and adjusting elevator.

7. Painting of all work other than elevator work.

8. All cutting and patching of beams, walls and necessary masonry work required, including repairs to plaster.

9. Car operator if machine is used under temporary permit for construction purposes previous to Acceptance of Contract.

REGULATIONS CONTROLLING:

All work shown and/or specified herein shall be furnished, installed and finished in accordance with the requirements of the Industrial Accident Commission of the State of California and especially their "Elevator Safety Orders". Also the work shall be done in accordance with the Building Laws of the City and County of San Francisco.

SHOP DRAWINGS:

The Contractor shall prepare all shop drawings necessary to show the general layout, clearances, position of sheaves and machine beams, location of guides, sheaves, feeders for controller and other necessary data.

TEMPORARY USE:

After the machinery, hoisting apparatus and car platform are set, the elevator may be connected up temporarily and used for construction purposes. In which case the sub-contractor (Otis Elevator Company) will do the necessary temporary mechanical work, make necessary connections and give the Contractor the permission to use the Elevator. The Contractor shall construct a temporary enclosure around the car and shall do and perform such operations and work around the elevator installation as may be required by the sub-contractor.

DESCRIPTION:

Load	2000 lbs.
Speed	125 ft. per minute.
Travel	Ground to Belvedere floor, about 123'0"
Stops.	Three
Openings	Three
Control	Car Switch
Platform size . . .	5'9" x 4'8"
Machine location . .	Overhead
Power	220 volts, 3 phase, 60 cycles.

The elvator shall be installed in accordance with the following details;

MACHINE:

The machine shall consist of a driving sheave with demountable rim, single worm and gear reduction and motor. The driving sheave rim shall be of the best grade semi-steel turned true and machine grooved, and shall be rigidly connected to the worm wheel. The worm shall be cut from a solid forging and shall mesh with a gear of phosphor bronze. The worm and gear shall run in an oil tight housing. The motor shall be especially designed for elevator service and be capable of withstanding temporary overload and shock occasioned by frequent starting and stopping with maximum load. The motor shall have a steel frame so designed as to protect the windings from injury, and to allow easy removals of the rotor. The motor, gearing, sheave and brake shall be mounted on a one piece cast iron bed plate. The end thrust of the worm shall be taken up by single self-aligning ball thrust bearings readily accessible and replaceable without removing the brake pulley.

MOTOR:

The motor shall be of the single speed induction type wound for 220 volts, 3 phase, 60 cycles. This motor shall not operate over 1200 r.p.m. and the rotor shall be of the squirrel cage type having high resistance end rings and with connections between bars and end rings of such design that these connections will not be affected by the contraction and expansion of the bars or rings due to heat developed in the ring The capacity of the motor shall be sufficient to start and operate the elevator at specified speed under the maximum conditions of specified superimposed load, and to continue the operation as may be required by the existing conditions at the place of installation without exhibiting a rise of temperature greater than 55 degrees C. in any part.

BRAKE:

The brake shall be of the electro-magnetic type, quiet and positive

in operation. Brake shall be readily adjustable and shall be of sufficient power to stop and hold the elevator u nder maximum loads at all times.

CONTROLLER:

The controller shall be of the latest electro magnet type with carbon to copper contacts, operated by means of a switch in the car. The controller shall be constructed of slate free from metallic veins, mounted on an angle iron frame. The contact surfaces shall be so arranged so as to be readily accessible, and all wearing parts shall be of ample dimensions to meet the requirements of elevator operation and control. The controller shall be arranged to make and break the circuit and reverse the elevator motor without destructive arcing, give smooth acceleration and retardation to the car, secure the motor against damage from overload or excess current, prevent admission of more current than may be required to perform the specified duty of the elevator. When the power is thrown off the controller shall slow down the motor and supply the brake bringing the car to a stop. The controller shall also be provided with an electro magnetic relay which will prevent operation of the elevator in case of phase failure, phase reversal, or low voltage in the supply circuits. The controller shall be provided with a sequence relay.

OPERATING DEVICE:

The operating device shall consist of a switch in the car, so arranged as to return automatically to the neutral position when released by the operator. The switch shall be set in a cutout provided by the ornamental car contractor, the face of the switch being practically flush with the inside of the car. The car light switch, the switch to cut off the current supply to the motor, and the break glass switch to cut out the hatchway door interlocks in case of emergency shall be mounted in the same case with the car switch. The face plate of the car switch shall be made of solid bronze.

FOUNDATION:

The machine shall be mounted at the top of the hatchway upon st eel beams which shall rest upon the structural supports of the building. The elevator contractor shall arrange with the concrete contractor for proper slots to be left in the floors for the passage of the cables. All concrete work for the penthouse floor will be poured by others after the machine is in place in accordance with drawings prepared by the elevator contractor.

GUIDE RAILS:

The car and counterbalance guide rails shall be of heavy steel tee sections erected in lengths not less than 16'0" each except jumper rails which may be 12'0". The guide rails shall be planed or milled on face and on sides to a uniform thickness and the ends shall be tongued and grooved forming matched joints.

The rails shall be fastened to the hatchway framing beams with structural steel or iron brackets. 9" channel backing shall be prov- for main guides where the distance between brackets exceeds 13 ft. All rails are to be jointed with heavy splice plates having not less than four bolts in each rail to be joined.

Main guides shall weigh not less than 15.5# per lineal foot and shall measure not less than 5" x 3-1/2" x 5/8". Counterweight guides shall weigh not less than 7.8 lbs. per lineal foot and shall measure not less than 3-1/4" x 2-7/16" x 5/8".

CAR FRAME, SAFETY AND GOVERNOR:

The platform and car shall be supported by means of a structural steel frame, securely riveted and bolted together and provided with spring adjusted, self-aligning guide shoes. The car frame shall be equipped with a safety of the instantaneous type operated by means of a centrifugal governor designed to cut off the current, apply the brake and bring the elevator to a stop, should the car attain excessive descending speed.

PLATFORM:

The car platform shall be made of well seasoned wood set in an angle steel frame, fireproofed underneath with sheet metal and provided with linotile flooring and bronze threshold plate at car entrance.

ROPES:

The elevators shall be equipped with suitable steel traction ropes passing around the driving sheave and connecting the car and counterweight. Not less than 4 1/2" cables shall be provided for the elevator.

COUNTERBALANCE:

The elevator shall be provided with counterbalance proportioned to insure smooth and economical operation.

The counterbalance frame shall be constructed of structural steel shapes, securely bolted, riveted or welded together. Adjustable guide shoes shall be provided at the top and bottom of the elevator counterbalance frames. The cast iron weight sections shall be firmly secured within the frames by not less than two tie rods which shall pass through holes in each weight section and not through open slots. The frame and tie rods shall be provided with lock nuts and cotterpins at each end.

BUFFERS:

Heavyspring buffers shall be provided under the car and counterweight as a means of bringing either of them to a gradual and positive stop at the extreme limits of travel, should the car run by the final limit switches. Buffers shall be mounted in the elevator pit upon structural steel bases.

LIMIT SWITCHES:

Automatic limit switches of the enclosed type shall be provided in the hatchway which will gradually slow down and stop the car when it reaches the top or bottom landings.

ANNUNCIATOR:

The elevator shall be provided with a flush type aluminum finish

"Up and Down" annunciator in the car containing "Up and Down" indications for each landing, connected to one push button riser of hall push buttons consisting of "Up and Down" bronze hall push buttons at each intermediate opening and single push buttons at each terminal opening.

MECHANICAL DIAL:

There shall be a mechanical dial placed over the ground floor opening. This shall be half- dial, design D-15, finish bronse. It shall register "B M T" (Bottom-Middle-Top).

PAINTING:

All exposed work and equipment under these specifications shall be properly cleaned and painted two coats of lead and oil paint.

GUIDE LUBRICATORS:

Guide lubricators shall be provided for each car and counterweight guide rail, located on the top of the car and counterweight and arranged so to suitably lubricate all guide rails.

BAR INTERLOCKS:

The elevator contractor shall furnish and install necessary electric bar interlocks on each of the hatchway doors. These electric interlocks shall be connected to the operating circuit of the elevator arranged so that the elevator cannot be operated until all hatchway doors are closed and locked.

EMERGENCY RELEASE SWITCH:

An emergency release switch of the break glass type shall be mounted in each car switch case which shall allow operation of the elevator in an emergency with the hatchway doors open.

WIRING:

The electrical sub-contractor shall bring the necessary power feeders to the terminals of the elevator controller, including main line switches and fuses as required.

The elevator sub-contractor shall provide and do all wiring beyond

this point. All conductors shall be single braid rubber covered soft drawn copperof the highest conductivity, made in strict accordance with the latest National Electric Code Requirements. With the exception of a flexible cable connected to the car and the annunciator wiring, all conductors shall be enclosed in steel conduits. These connections which may be so short as to be self-supporting need not be enclosed in conduit but shall be protected from abrasion or other mechanical injuries. All conduits shall be rigidly supported and shall terminatein approved conduit fittings.

CAR & GATES

CAR ENCLOSURE;

The ornamental elevator car shall be furnished and installed complete by this contractor, of Itis design #2-A, and shall conform to the following;

Side and rear panels and canopy shall be constructed of #14 gauge first grade metal furniture steel, one side of which shall be perfect and free from surface defects. Mouldings and drawn shapes shall be constructed from #16 gauge furniture steel. The top and bottom edges of the panels and around the outline of the cutouts shall be reinforced with angles and straps spot welded to the rear of the panels. Additional angle reinforcing shall be spot welded to the rear of the panels where required to insure the rigidity of the panels. Grilles of fish scale #307 design shall be provided as shown on design of cast aluminum.

The car shall be provided with a dome light in the centerof the canopy of standard design as selected.

The car shall be provided with aluminum entrance columns at the car entrance.

A single round hand rail, as selected, shall be provided around the two sides and the rear of the car. This hand rail shall be securely fastened to the car sides and shall be constructed of solid aluminum.

The car shall be provided with a solid aluminum kick plate around the base of the car and approximately 6" high.

All steel parts of the car shall be sand blasted to insure a clean surface. The sand blasted parts shall then be placed in a parkerizing tank, remaining there until the parts are thoroughly parkerized. All panels shall then be brushed and washed so as to be ready for the application of the finishing lacquer coats. Three double coats of pigmented lacquer shall then be applied with an air brush, each double coat except the last being thoroughly rubbed with sandpaper and gasoline. One double coat of finishing lacquer shall then be applied.

Aluminum shall be finished with sand blast and clear lacquer.

The interior of the car shall be finished in one color lacquer with the car canopy another color.

The interior car fixtures shall be finished to harmonize with the aluminum.

CAR GATE:

The car opening shall be protected by a channel type solid aluminum collapsible car gate. The car gate shall be made up of solid aluminum channel uprights 5/8" wide with three sets of aluminum lacing supported at the top by ball bearing sheaves running on a cold rolled steel track. The car gate shall be provided with handles on both sides equipped with aluminum guard plates. Finish shall be sand blast.

CAR GATE CONTACTS:

The car gate shall be provided with an electric contact arranged so that the elevator can not be operated unless the car gate is closed.

ELEVATOR ENTRANCE ENCLOSURES

The work included under this heading shall be furnished strictly in accordance with the specifications herein outlined.

MATERIALS:

All steel used in the construction of enclosures described herein,

except rough bucks and structural members shall be of the best grade open hearth full cold rolled, full pickled, double annealed, patent leveled sheet furniture steel entirely free from scales and pits, of the U.S. Standard gauges specified under the various headings.

WORKMANSHIP:

All work shall be executed and finished to conform to the generally accepted standards as established by the hollow metal manufacturers in the United States. The finished work in all cases shall be smooth and free from warps and buckles. All moulded members shall be clean cut, straight and true. All mitres shall be well formed and in true alignment and welded joints shall be neatly made and cleaned off flush.

DOORS:

All hatchway doors shall be of the flush panel type, hollow metal construction, center parting of standard thickness and construction, as follows; Doors shall be made of two #16 ga. steel plates, properly formed and rigidly connected and reinforced by means of suitably formed sections spaced not more than 8" apart within the doors. Suitable sound deadening material shall be placed between these reinforcing sections.

Interior reinforcements, as required, shall be provided for keyholes, hanger pendant bolts, and operating devices to be applied to the elevator doors. At the bottom of each sliding door provide and attach two 1/2" x 5/8" x 3" 65% carbon steel or lignum vitae guides with maximum toleranceof .007 inches between guide and groove in sill.

Each door shall be stamped on top with number of opening in which it is to be installed, and also a clear designation showing its respective location in the opening. In order to distinguish hatch from corridor side, markings shall be arranged to read from hatch side.

ROUGH BUCKS:

Rough bucks shall be not less than #12 gauge blue annealed pressed steel, formed as detailed and properly and securely fastened to sill and structural members of enclosure.

JAMBS:

Cabinet jambs constructed of #13 ga. steel are to be furnished detailed to finish over buck construction. Jamb intersections shall be neatly coped. Reinforcements and mortises shall be provided for any latch strikes, parts of interlocking mechanism, and similar items, to co-ordinate this part of the hollow metal work with operators, interlock and hardware.

TRIM:

Trim shall be of standard design as selected with the mitres neatly fitted, welded and cleaned. Concealed fastenings shall be provided where specified. Where concealed fastenings are not required, the casing shall be drilled, countersunk, and supplied with French head machine screws.

SILLS:

Sills shall be constructed of close grain cast grey iron with n- slip design surfaces, with nosings on the shaft side and machine planed grooves for door guides. All sills are to be straight and free from warps, set true, level and properly anchored to floor construction; Sills shall extend in width as shown on plans, to be of sufficient length to permit mounting of struts thereon, and shall receive one shop coat of metal primer before being set in place.

STRUTS:

Structural steel angle struts, for support of fronts, shall be provided in accordance with details; to be not less than 3" x 3" x 5/16" angles properly and securely bolted to sill and concrete walls above hanger plates.

HANGER COVERS:

Removable cover plates of not less than #12 gauge steel shall be provided. Cutouts shall be provided, when necessary, as required.

HANGER PLATES:

Hanger plates shall be formed of not less than 3/16" steel and se-

curely fastened to bucks and strut angles, and this contractor shall drill and tap them for hangers.

HANGERS:

All elevator doors shall be hung on center opening geared hangers provided with two sets of ball bearings rotating on two tangent points. The door to be hung centrally between the two sets of balls eliminating friction and cantilever effect to a minimum. The track shall be cold rolled steel of #13 ga. with smooth ball race and so constructed as to form a housing to protect raceway against dirt. This Contractor shall install hangers and hang elevator doors.

Hangers shall be bolted to top of doors by means of pendant bolts and designed to properly support doors; each panel not to exceed 200 lbs in weight.

Gearing to consist of specially designed sprocket and chain to properly transmit power between doors.

BUMPERS:

Provide gum rubber bumpers with iron supports properly located at both top and bottom of doors for stopping doors when fully opened and on door or strike jamb for stopping doors when fully closed to prevent contact of metal parts.

SIGHT GUARDS:

Sight guards shall be provided on each side of opening for all hatchway doors. They shall be at least 5" wide, extending from sill to hanger pocket and may be integral with or separate from the jamb. Material and finish shall be the same as the jamb.

FACIA PLATES:

Facia plates shall be provided of not less than #14 gauge steel and shall extend from the top of hanger pocket to the sill above and at least 5" on one side and 12" on the other side of the finished opening. Fastening shall be made to the sill above and struts or intermediate

stiffeners shall be provided as required.

FINISH:

Both sides of all hollow metal doors, metal jambs and trim shall be finished in a light shade of prime coat metallic paint by this contractor. Finishing paint shall be included in the Painting Section of these Specifications.

The prime finish shall be applied as follows. After shop work is completed material shall be thoroughly cleaned and coat of rust inhibiting paint shall be applied to the interior and exterior surfaces and baked on. The baked enamel surfaces shall have two or more coats of mineral baking filler which shall be applied to cover weld marks for uneven surfaces, baked on and sanded smooth.

All structural steel framing, angles, struts, etc., shall be painted with one shop coat of metal primer.

ERECTION

This Contractor shall erect, complete, all portions of this work as herein described, plumb and in correct relation to elevator guide rails. All exposed finished surfaces of enclosure shall be adequately protected against damage and after final completion of elevator, finished surfaces shall be cleaned and polished.

DETAILS:

Complete shop details showing type of construction and necessary full size drawings to show profiles of frames and mouldings shall be prepared and submitted to the Architect for approval.

SERVICE

For a period of three months after completion of the elevator, the Contractor shall furnish service consisting of a weekly examination o the elevator, including oiling and cleaning machine, motor and controller greasing bearings and guides;necessary minor adjustments;callback ser-

vice and furnishing of all carbon and copper contacts, contact i nsulations and contact springs, motor brushes, oils, greases, rope preservative and cotton waste.

ADDENDA:

To CAR & GATES:

Where aluminum is specified above for trim in the interior of the car and the car gates, use solid bronze-white finished

BRICK & STRUCTURAL TILE WORK

WORK INCLUDED;

This Section of the Specifications shall include the furnishing, setting and finishing of all Brick and Structural Tile work as is shown, indicated or noted on the accompanying drawings and/or specified herein, this includes all paving brick, adjacent cement step work, hollow tile work, enameled tiled units, etc.

LOCATION;

Paving brick; Paving brick is shown as forming a mat in the center of four steps and the landing of the main front entrance.

~~Structural Tile; Structural terra cotta partition tile is shown in the partitions between the kitchen and the storage room, the furnace room and the janitors closet, and one doorway on the second floor.~~

~~Tile Units; Tile units are shown in the three partitions between the Kitchen and the restaurant.~~

MATERIALS;

Previously Specified; Standard Portland cement, sand and admixtures are specified in the Concrete Section of these Specifications.

White cement; White cement shall be Medusa or Atlas White cement waterproofed.

Paving brick; Paving brick shall be vertical fiber brick. It shall conform to the Standard Specifications and Tests of the American Society for Testing Material, Serial Designation #C-7-15 as latest revised. The brick shall be regular in size and shape and specially burned for paving purposes. They shall have the following dimensions; 2-1/2" x 4" x 8-1/4" Their edges shall be slightly beveled. One edge and one end on each brick shall be practically perfect as to appearance, smoothness, texture and color. When broken, the brick shall show a dense, stonelike body, free from lime, air pockets, cracks and marked laminations. Color shall be dark red.

~~Structural Partition Tile: Structural partition hollow tile shall comply with U. S. Government Specifications #508. They shall be Class M. Both faces shall be smooth. These tiles shall be uniform in size, the faces out of wind and free from cracks, flaws or similar defects. They shall be 4" thick.~~

LAYING PAVING BRICK:

All of the step work shown, both brick and concrete, shall be included in this Section.

Bedding concrete shall be composed of one part of Portland cement to seven parts of sand and 1/2" stone aggregated with the admixture. The brick shall be bedded in the concrete before it has taken its set. The brick shall be bedded with cement mortar using one part of Portland cement to three of sand with the admixture. Brick shall be thoroughly drenched before laying. Each step shall be pitched 1/4" from back to nose. All brick shall be laid on edge with 3/8" joints. Tread brick shall run under the riser brick above, and shall be flush with the riser brick below. Treads shall be in even plane and risers vertical. Joints shall be kept in accurate alinement as shown.

After the bedding and before pointing, the brick will be inspected and any defective brick replaced. No other moving or working of the brick will be allowed during the bedding process.

When the bedding is set, the brick joints shall be grouted full and flush and pointed with white cement and sand. The joint shall be finished with a slight sinkage below the faceof the brick.

ADJACENT CEMENT WORK:

The steps and landing adjacent to the brick mat shall be finished after the bedding and pointing are set hard, allowing at least one week for the setting.

The steps and landings shall be formed in concrete to finish at the same planes as the brick work and to be an extension thereof. The core of the steps and platform shall be formed with the bedding concrete and finished with an integral topping not less than 3/4" thick of the pointing mortar. Where the cement finish adjoins the brick, run a small V or bevel to correspond with the brick edges. The surfaces of the cement shall be floated hard and to the required lines with the wood float and then finished by deckling with a stiff brush as directed.

Form a sinkage 3/4" deep in the center of the platform and in the brick as shown for a foot mat.

~~LAYING PARTITION TILE:~~

Hollow tile shall be drenched and laid damp. The webs shall be laid horizontally. The bottom course shall be filled with cement mortar, using the mixture specified above. Each course shall be reinforced with a strip of galvanized wire cloth, using #13 gauge 2-1/2 mesh. The cloth shall be 3" wide and run the full length of the joint. Build in bucks for the doorway anchoring the same firmly in place. Horizontal joints shall be level and vertical joints broken at least 3". Door lintels shall be reinforced with two 1/2" rods and the voids filled with cement. Faces of the tile shall be finished flush, joints shall be struck flush ~~and even.~~

~~LAYING TILE UNITS:~~

~~Tile units shall be laid similarly to the hollow tile, including~~

ALTERNATES

The contractor shall state in his bid a separate price for each one of the following Alternates. If any one or all of the alternates be accepted, the price thereof shall be added to amount of the basic bid and the combined amounts shall be the amount of the Contract Price. The acceptance or rejection of these Alternates will be decided before the contract is signed.

If an Alternate is accepted it shall be integral part of the contract. All material, labor, methods, etc., used in the construction and finishing of the parts covered by the accepted Alternate shall be the same as specified in the body of these Specifications.

ALTERNATE #1: (Sheets No. 1 & M-2) Modify to suit new Drawings

This alternate includes all work and material for the terrace surrounding the building, extending from the limit of Alternate #4 on the north side to and including the rounded end of the terrace on the south side. It includes the cement walk around the building and around the south terrace. The steps and rail up to the south door of the restaurant are included in the main contract, and should not be figured as part of Alternate #1.

It does not include the five cement benches or the six holes that are shown or any of the steps and landings running down to the driveway on the south.

The two openings left in the south parapet by the exclusion of the steps shall be filled in with brick and cement plastered to match the rest of the parapet.

The section of tile pavement marked "Included in Contract" shall be included in Alternate #1.

The electric work specified in Section #18 of these specifications is included in this Alternate. The electroliers are not included.

ALTERNATES #2 & 3:

These two alternates shall be disregarded for the time being.

ALTERNATE #4: modify to suit new drawings.

This alternate includes all work and material for the terrace at the present stair head and connections and alterations thereto and connections to Alternate #1. The tile pavement is included in this Alternate This tile paving work and that in Alternate #1 shall be done as specified for similar work in the Restaurant floor and similar parts.

The electric work specified in Electric Section #18 shall be included in this Alternate #4. The bracket fixtures are not included.

ALTERNATE #5:

Furnish and set complete on the north side of the building, where shown on Sheet #1, one metal pedistal drinking fountain. This shall be connected complete to the cold water line and may be wasted down the hill if the Sanitary Laws permit, otherwise it shall be wasted as required. The fountain pedistal shall be Design #195 bronze of the Oregon Brass Works, or similar thereto. The head shall be an arc spout as approved.

B P Lamb OWNER

John Davis Hatch WITNESS

Young & Hardwyn CONTRACTOR
Paul B Young.

JAN 17 1933

EXHIBIT BB.

REPORT ON DETERIORATION OF EXTERIOR COMPONENTS

PREPARED BY: INTERACTIVE RESOURCES, INC.
PREPARED FOR: BUREAU OF ARCHITECTURE,
DEPARTMENT OF PUBLIC WORKS,
CITY AND COUNTY OF SAN FRANCISCO, CALIFORNIA
MAY 1985

Report on Deterioration of

Exterior Components

at

Coit Tower

Project # 4609A

By

Bureau of Architecture
Department of Public Works
City and County of San Francisco
San Francisco, California 94102

Consultant

Interactive Resources, Inc.
Structural Engineers
117 Park Place
Point Richmond, CA 94801

For

Recreation and Parks Department
City and County of San Francisco

May 1985

Interactive Resources, Inc.

17 May 1985

Mr. Norman Karasick, City Architect
Bureau of Architecture
City Hall, Room 265
San Francisco, CA 94102

Subject: **Coit Tower Investigation**

Dear Mr. Karasick:

We are pleased to present the proposed report on the Coit Tower investigation. Thank you for your support and the cooperation of your staff and the Coit Tower personnel.

An **Executive Summary** opens our report capsulizing the findings of the investigation. The balance of the report is outlined to expand on the information given in the Executive Summary.

Thank you for the opportunity to assist you on this investigation. We hope the findings therein will be useful and that necessary safety repairs can be initiated quickly.

Sincerely,

John E. Clinton, S.E., R.A.

JEC1530may

Enclosure

117 Park Place
Point Richmond
California 94801
415-236-7435

Architects and
Engineers

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Objective

The objective of this investigation was to evaluate the extent of exterior concrete deterioration at Coit Tower and to estimate the scope and cost of associated restoration.

Scope

The investigation of Coit Tower included a field survey of the base walls, the Belvedere level and the roof level. To save duplication of scaffolding costs, a complete survey of the tower wall was deferred until repairs are underway and the contractor's scaffold is in place. Various types of deterioration were recorded in sketches and photographs which appear later in this report. From the field survey, recommended repairs have been outlined to restore the integrity of the structure and an estimate of repair costs has been tabulated. An investigation of roof leakage at the base level, as well as other water-related problems at the roof and Belvedere levels, has been completed by others and is included in Part III, N, of this report.

Report Summary

At the **Tower Base Level**, both the exterior first floor and second floor walls as well as the entry walls, planters, stairs, walkways and retaining walls near the tower were examined. The concrete surface has many spalls or breaking off of concrete due to corrosion of reinforcement below. These spalls are especially prevalent on the fascia beam over the four columns, although many are obscured by unsightly, previous patches. There is also evidence of cracking and water damage on the beam soffit.

The **Tower Shaft** is marked with an estimated 5,000 small spalls, or popouts, about 3 inches in diameter, caused by corroding form ties from the original construction. The thin stucco coating placed over the entire tower is flaking off in many locations.

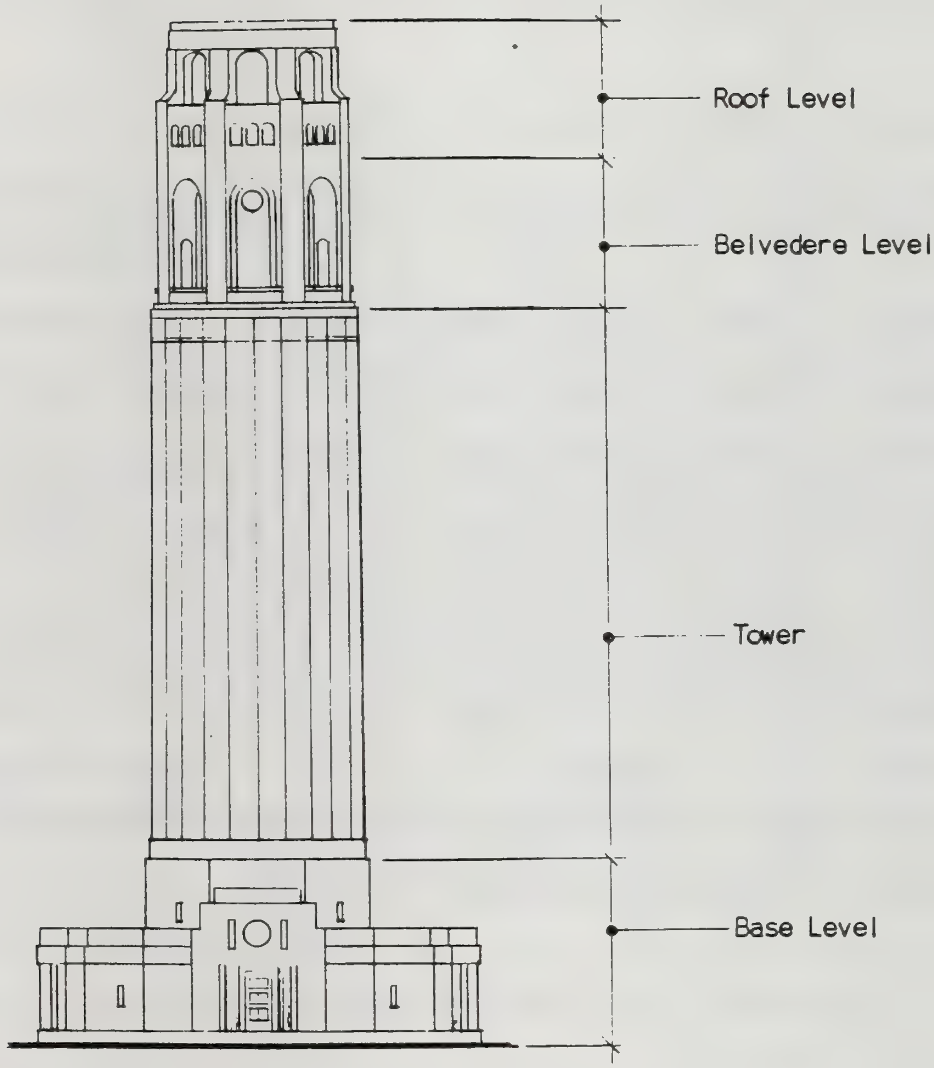
At the **Belvedere level**, the tall, exterior columns are seriously damaged by long, vertical cracks. The balustrade is severely chemically eroded and cracked. Pieces of the balustrade are breaking off and may create a hazard for people and property below. The **Roof Level**, with its two levels of arches, has many small spalls, as well as large spalls at non-operational lighting fixtures, and exhibits extreme peeling of the stucco coating.

It is proposed that all spalls, whether currently patched or not, receive a new, properly prepared patch to restore structural integrity and arrest future deterioration. Serious cracks should be opened to determine if the reinforcement below is corroding, necessary structural repairs performed, and a concrete patch applied. Small cracks may be injected with epoxy or remain unrepaired. Finally, to protect the surface from future deterioration, a new surface coating should be applied. Before final repair techniques and materials are specified, they should be tested on the Tower to verify their structural adequacy and visual appearance.

A brief analysis of the Tower indicates that the tower structure should remain stable during a moderate seismic event. However, as mentioned above for the balusters, certain deteriorated elements could be easily dislocated and become a safety hazard. A review of the proposed elevator improvement plans revealed no serious problems to the Tower's structural system.

Limitations

The information in this report is based on the investigation and evaluation of of only those items noted in the above scope. The investigation and evaluation did not include a thorough review of the entire structure or any analysis of items not mentioned, such as electrical and mechanical systems.



Elevation of Coit Tower
Showing General Location of Areas Investigated

Estimated Cost for Repairs [1,2,3]					
PART 3: (see text for Areas A, B, C & D)					
Item	Base	Tower	Upper	Grounds	Total Repair Cost
E. Cracks					
Minor....................	1,800	--	4,700	1,500	8,000.00
Major..................	32,100	--	40,100	--	72,200.00
F. Small Spalls (Form Ties).....	7,300	254,400	36,500	6,600	304,700.00[4]
G. Large Spalls					
Walls..................	16,000	--	21,900	8,000	45,900.00
Lintel Beam Repair......	21,900	--	--	--	21,900.00
H. Surface Coating Delamination					
Surface Cleaning........	7,500	9,000	3,000	4,500	24,000.00
Concrete Surface Treatment	47,400	56,900	19,000	28,400	151,600.00
Sealer.................	20,600	24,800	8,400	12,400	66,200.00
J. Balustrade Replacement.......	--	--	23,300	--	23,300.00
L. Lobby Crack.................	4,400	--	--	--	4,400.00
M. Soils-Related Repairs........	--	--	--	59,000	59,000.00[5]
Tower Scaffolding...........	--	60,000	--	--	60,000.00[6]
Allow for Inaccessible Areas.	--	--	36,500	--	36,500.00
TOTAL........................	159,000	405,100	193,400	120,400	877,700.00

1 Cost based on completion date of October 1985.

2 Includes materials, labor, contractor overhead, profit, and construction contingency.

3 Due to the nature of reinforced concrete deterioration, the extent of damage in certain cases cannot be completely assessed until demolition has begun. Consequently, the actual repair cost may vary.

4 A less rigorous repair may reduce this estimate to $124,000.

5 Includes walkway replacement at west side of tower, front retaining wall replacement and repair of planter drains.

6 Scaffolding cost estimate is based on a 4 month time allowance with either a fixed or cable scaffolding system.

RESTORATION PROGRAM OPTIONS			
		A	B
		As Recommended In Report[1]	Reduced Scope
		Structural Repairs, Cleaning, Surface Treatment all Areas	Structural Repairs only at Base, Upper and Grounds Clean Surface and Apply Alternate Coating only at Base and Accessible Areas of the Upper Level
Structural Restoration	Base	151,700.	123,700.
Structural Restoration	Tower	150,700.	--- [5]
Structural Restoration	Upper	156,900.	141,100.
Structural Restoration	Grounds	113,800.	14,000.[4]
Architectural Restoration	Roofing Work	51,500.	51,500.
Architectural Restoration	Handicap Access & Misc.	55,000.	55,000.
Architectural Restoration	Elevator Rehab.	113,000.	113,000.
Subtotal		792,600.	498,300.
HRC + Cont.		158,500.	99,600.
Total Contract		951,100.	597,900.
Project Cost		190,200.	119,600.
TOTAL PROJECT		1,114,300.[1,2,3]	717,500.[2]

1 Exception is form tie spalls not included, add $438,700 for form tie repair.

2 Estimates do not include credit of proposed gift toward surface coating.

3 Cost may be reduced $100,000 by replacing surface treatment and sealer with alternative coating.

4 Soils-related repairs have been deleted. Work to be completed if funds are available or in a 2nd Phase.

5 Work on the exterior surface of the tower shaft has been deleted. Work to be completed if funds are available or in a 2nd Phase.

PART I

SUMMARY OF FINDINGS

SUMMARY OF FINDINGS

Specific locations of deterioration are shown on drawings in Part II, Survey of Deterioration.

A. Base Level

At the tower base level, both the exterior first floor walls and the second floor walls adjacent to the tower were investigated. Photo 1, of the south wall, shows the typical condition. In addition to the walls forming the base, two wing walls with doorways projecting from the north entry wall were inspected. The west wall is shown in Photo 2. Two major types of deterioration are evident. These are cracking of concrete and surface spalling or separation of concrete due to corrosion of reinforcement. Each problem takes several different forms and may have several different causes. Each requires correction to prevent further deterioration. In addition, the concrete finish coat is chipped and badly discolored in many locations.

Cracks occur at the base walls at a variety of locations. Most are caused by exposure to severe weather and inadequate concrete cover over reinforcement. Photo 3 shows vertical corner cracks occurring at the base of a wall. As seen in Photo 4, additional cracks occur around

1. South Base Elevation

2. West Wing Wall

windows, corners and other discontinuities in the walls. These cracks are not only unattractive, but also indicate a potential for further deterioration if not properly sealed.

Spalling is a serious problem at the base level. Photo 5 shows a typical large spall on the fascia beam. The corroded reinforcement and associated delamination are fully exposed. In many cases, the spalls have already been patched, as shown in the left of Photo 5. These patches vary in size, color and texture, creating an unsightly appearance. More importantly, the patches have questionable durability due to the use of higher strength, dissimilar concrete patch material with different expansion characteristics. This problem, along with incomplete patching techniques may be concealing ongoing hidden deterioration. Thus, to provide consistent and adequate protection against further spalling, it is recommended that all previous patches be removed and all spalls patched according to the repair procedures outlined in this report. In addition to the large spalls with exposed corroding reinforcement, there are many small (4 inch maximum diameter) spalls. These appear to be caused by form tie wires, left in place, which have corroded and popped off the surrounding concrete. These small spalls, though presenting no serious

3. Cracks at Wall Base

4. Cracks at Beam Soffit

5. Spall at Fascia Beam

structural problem, should be repaired to prevent future deterioration and to preserve the overall appearance and longterm integrity of the structure.

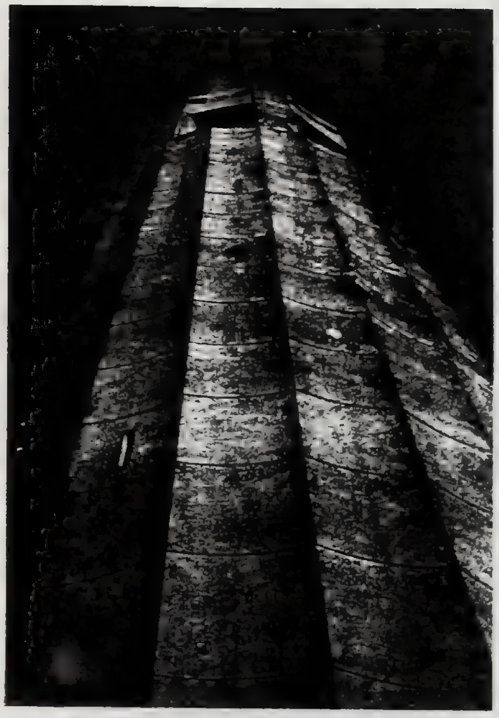
In addition to the walls actually attached to the tower, there are various retaining walls, planters, sidewalks and stairways associated with the Coit Tower Monument. Photo 6 shows a crack at the front entry wall. A few walls were obscured from investigation by plants, but a majority of them were thoroughly surveyed. In Photo 7, taken at the west side of the tower, the walkway has settled and cracked. Also, the retaining wall adjacent to this walkway has displaced 1 inch. These soil-related problems should be corrected to improve the appearance and performance of the retaining walls and adjacent walkways. In addition to these soils-related problems, the surface of the surrounding walls, planters and stairs exhibit spalls, cracks and surface coating peeling similar to the base level walls and should be repaired with the same techniques and materials used on those walls.

6. Crack at Entry Wall

7. Cracking at Walkway

Tower Walls

The tower walls, although not surveyed in detail at this time, were photographed and observed from the roof level and base level. From these observations, general conclusions about the extent of the deterioration can be drawn with a limited degree of accuracy. Photo 8 shows a sample of the apparent overall condition of the tower. With the exception of some chipping of the covering material and eroding of the fluted edges, the most prevalent visual problem is the occurrance of small spalls at form ties. These can be seen in Photo 9. From the ground, a large spall was observed at the top rim of the tower, indicating more extensive damage is present at certain areas. Our assumptions will be verified and any further tower deterioration will be specifically identified at a later date, when scaffolding is available to provide access to the tower surface.



8. Overall View of Tower

9. Form Tie Spalls and Surface Scaling

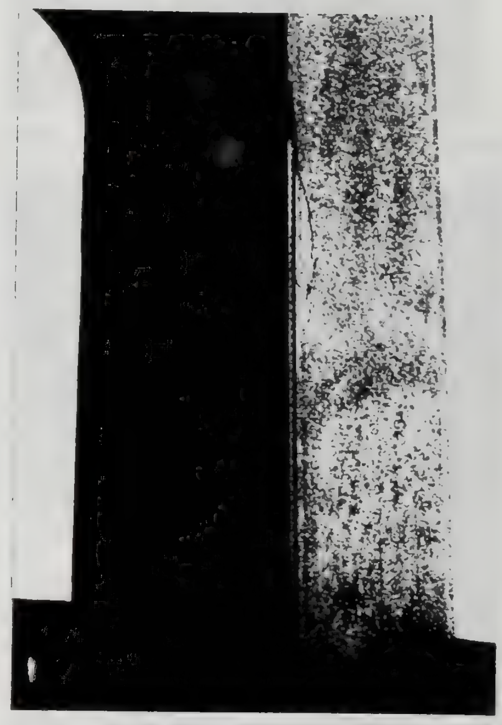
Belvedere Level

At the Belvedere Level, deterioration problems are similar to those at the base walls with the exception of damage at some specific areas unique to this level. Spalled concrete with exposed, corroded reinforcement; surface scaling of concrete covering; and spalled form ties are all typical problems.

The most unique and potentially dangerous problem at the Belvedere level is the severely scaled and cracked balustrade which forms the exterior railing between the arches. Photo 10 shows the typical balustrade condition. These balustrades have experienced extreme erosion and disintegraton and, as such, are a hazard to people and property below. The entire balustrade should be removed and replaced.

An additional recurrent problem at this level are the long, vertical cracks at the inside corner of the exterior arches as seen in Photo 11. These cracks range from 2 feet to 10 feet in length and from 1/4 inch to 1/32 inch or smaller in width, with the more severe cases occurring on the north side of the tower. In one case, shown in Photo 12, the

10. Balustrade



11. Cracks at Exterior Columns

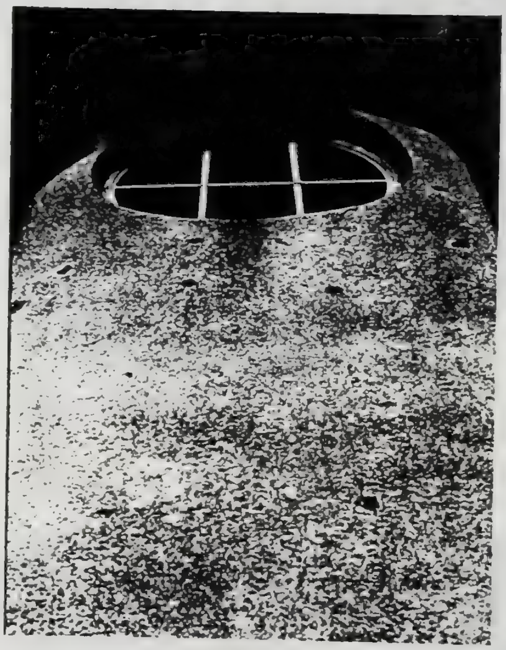
cracked concrete was chipped away to expose corroding reinforcement below. All these cracks should be opened up to assess the condition of the reinforcement below, and then be repaired as required.

The patterned form tie spalls seen in Photo 13, are another repetitive problem on the Belvedere Level. These occur mainly on the face of the tower core, and are arranged in a pattern. These spalls, as well as the scaling stucco finish coating, should be restorated to preserve the integrity of the concrete.

Water leakage has been observed below the light fixtures sunken in the exterior walkway slab. Section D-D on sheet 7 of the original drawings shows these light wells were intended to be a water catch basin as well. To arrest the water leakage, the catch basin and associated piping should be repaired.

Refer to the Roof Survey Report in Section N for a discussion of this problem.

12. Spalls at Exterior Columns



13. Form Tie Spalls on Core Wall

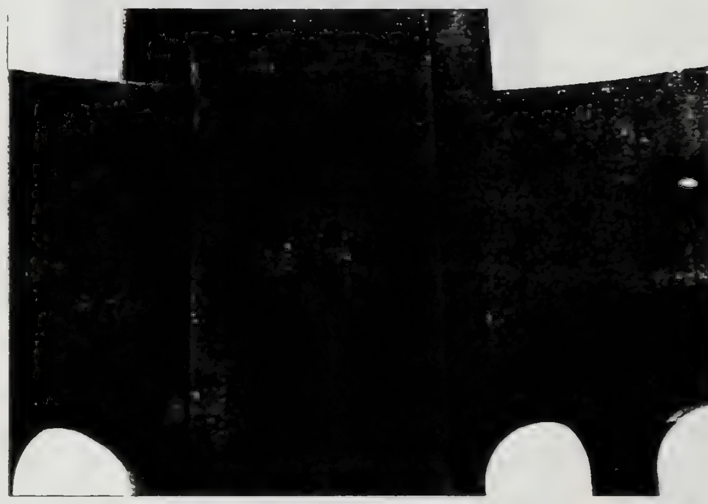
Roof Level

The Roof Level, which crowns Coit Tower, exhibits the types of deterioration seen previously, such as spalling and delamination of the surface coating. There are a number of exposed, corroding reinforcement bars with surrounding delaminations as well as smaller spalls at form ties. The stair walls also exhibit these types of problems, as seen in Photo 14. However, there are some problems unique in location and configuration to the roof level.

On the inside face of each column there is a square piece of corroding metal which was at one time part of a light fixture with a metal conduit extending back into the concrete. Due to weathering and the corrosion of the exposed metal, severe spalling has occurred, or will soon occur, at each location, as seen in Photo 15. To correct this situation, the light fixtures and hardware should be completely replaced or eliminated and the surrounding concrete repaired, as required.

Another unique problem occurring at the roof level is the severe delamination and spalling of the ceiling in each archway alcove. In several locations the concrete around the reinforcement has spalled. Photo 16 shows how the

14. Spalls and Cracks at Stairs



15. Spall at Light Fixture

16. Delamination at Ceiling

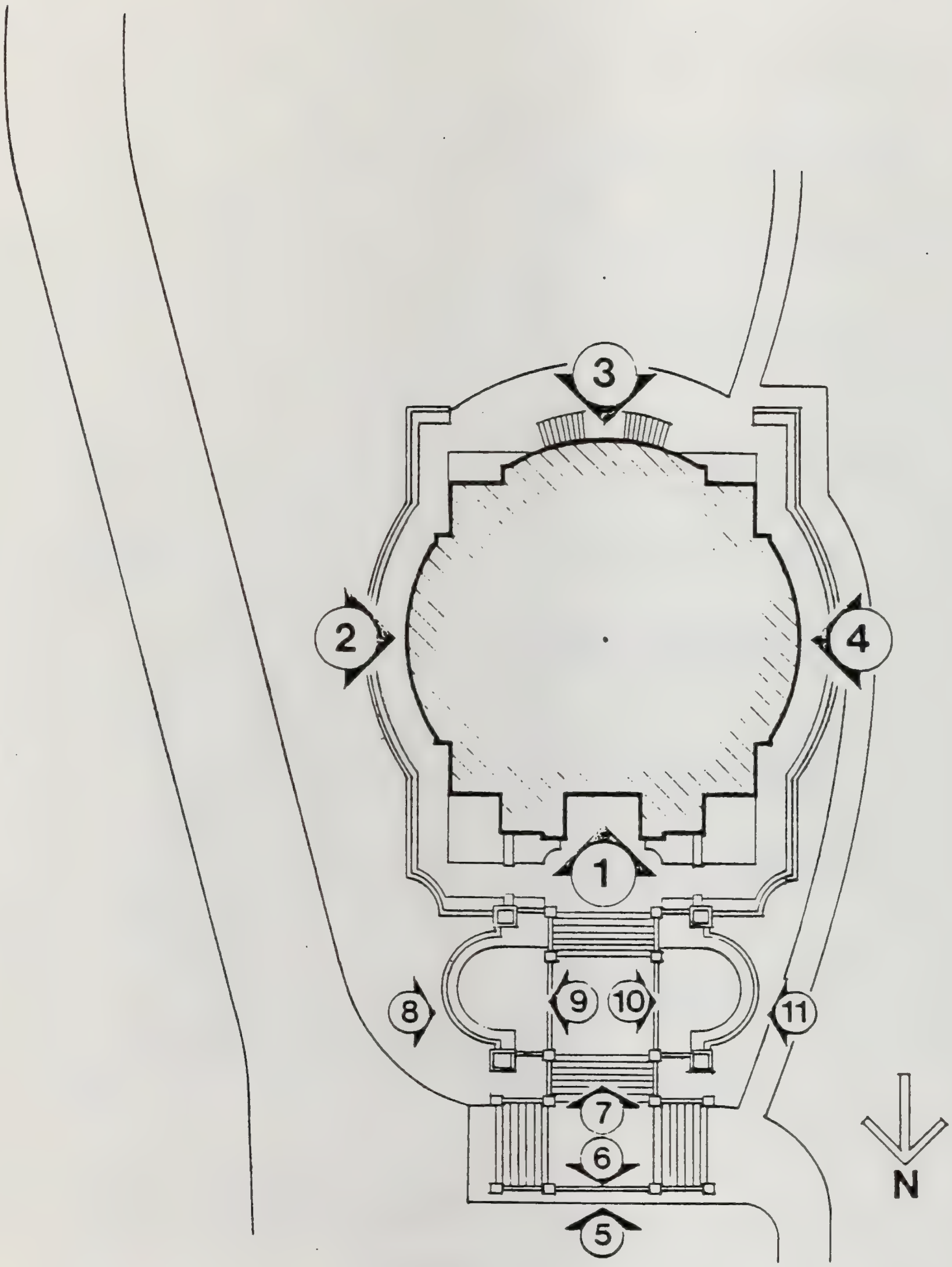
protective coating on the concrete has peeled off and indicates corroded reinforcement seats embedded in the concrete. Inspection of the roof above these alcoves revealed a depressed concrete area, unprotected from water penetration and probably without proper drainage. This condition may be contributing to the scaling on the ceiling. These spalls and delaminations, while occurring extensively on the ceiling, also appear on the walls, columns and arches at this level.

17. Form Tie Spalls at Upper Arches

In addition to these two problems, patterned form tie spalls were observed on the lower arches and the upper arches which form a ring at the top of the tower. Photo 17 shows a typical section of upper arches. The extent of these patterned spalls is similar to that found on the Belvedere level core walls.

PART II

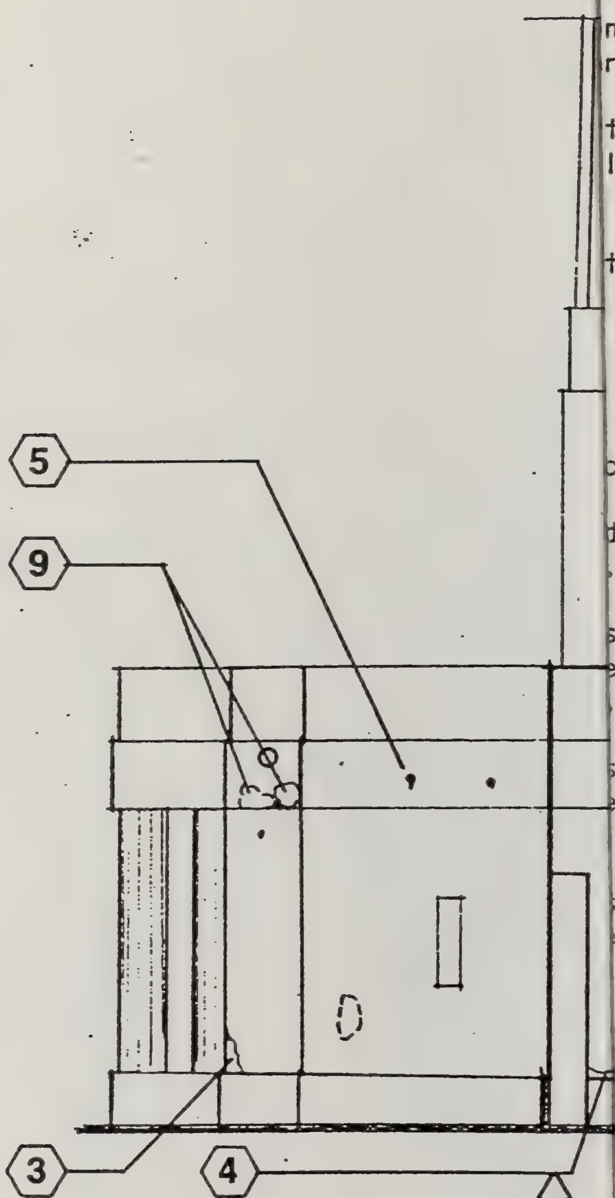
SURVEY OF DETERIORATION



COIT TOWER - PLAN VIEW

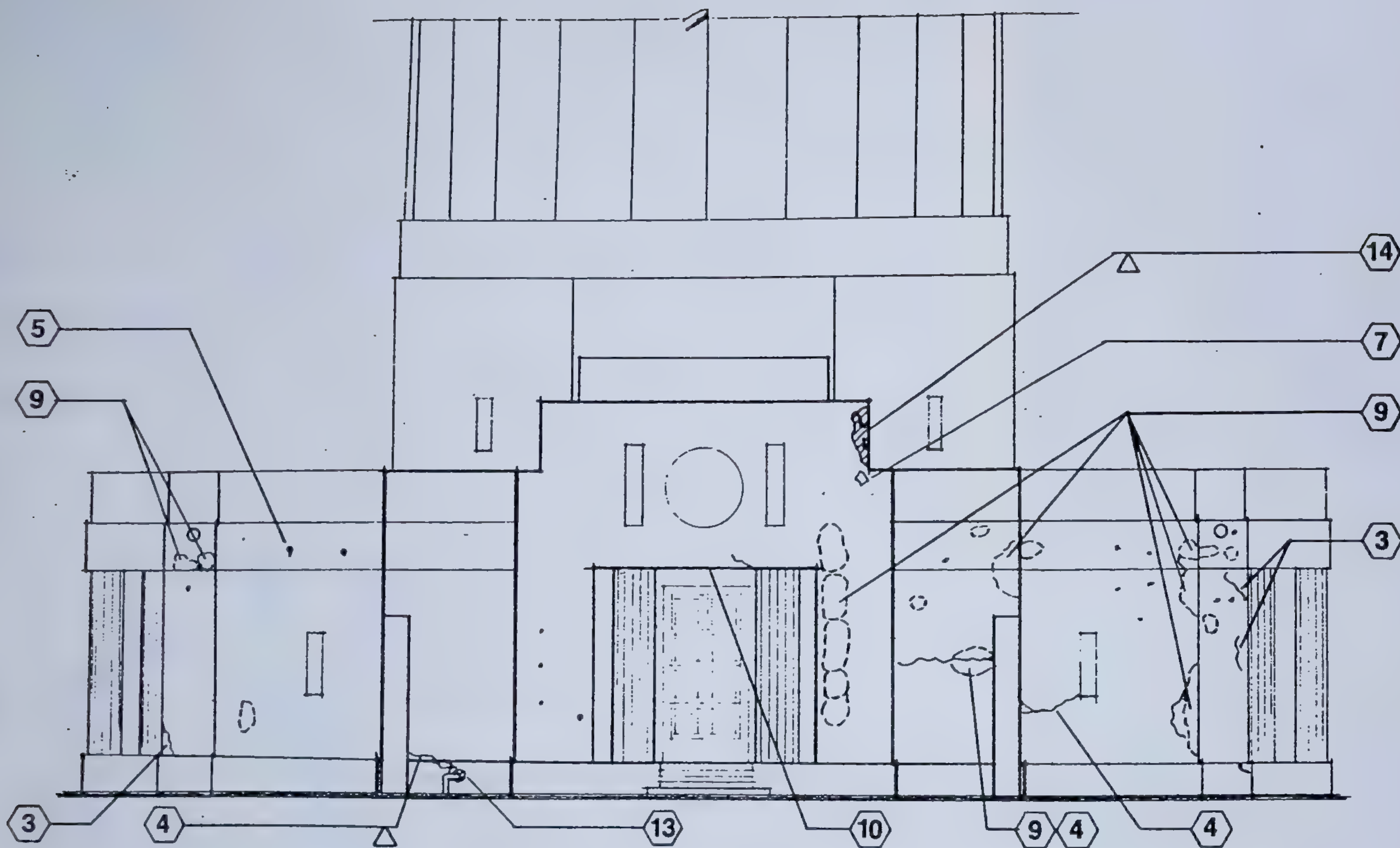
ASE WALL DETERIORATION SURVEY TABLE
NORTH ELEVATION

tion	Quantity	Sect.-Photo*
n 1/32" wide crack, up to ng, minor repair required.	N/A	E-c
n 1/32" wide crack, 4'-0" r, minor repair required.	N/A	E-b
than 1/32" wide crack, up long, major repair re-	14 Ft.	E-f
than 1/32" wide crack, longer, major repair re-	18 Ft.	E-g
diameter form tie spall, reinforcement exposed, or unpatched.	17 Ea.	F-a
d spall 4" to 8" in	N/A	G-a
spall due to corroded ement, 4" to 8" in	5 Ea.	G-e
spall due to corroded ement, 8" to 15" in on beam over columns.	N/A	G-b
spall due to corroded re- nt, 8" to 24" in	16 Ea.	G-g
it cracks, discolora- deterioration.	9 Ft.^{2}	G-c
nd delamination of surface coating.	Entire Surface	H-b
and water leakage at wall	N/A	E-h
and spalling around pipe.	1 Ea.	G-d
ll area above first floor	1 Ea.	G-f
patched crack in parapet	N/A	E-j
patched crack in second	N/A	E-j



1 NORTH ELEVATI

△ Photo referenced in De



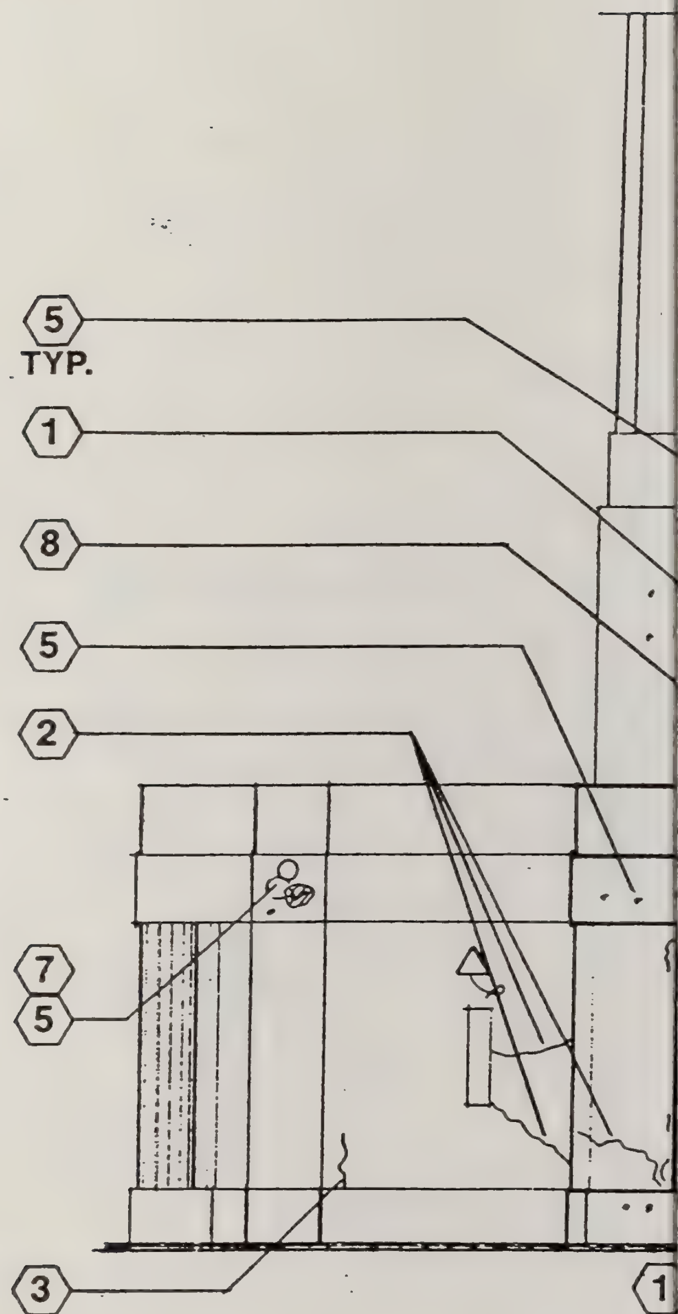
1 NORTH ELEVATION - BASE

△ Photo referenced in Deterioration Survey Table is of this area.

BASE WALL DETERIORATION SURVEY TABLE
NORTH ELEVATION

Item	Description	Quantity	Sect.-Photo*
1	Less than 1/32" wide crack, up to 4'-0" long, minor repair required.	N/A	E-c
2	Less than 1/32" wide crack, 4'-0" or longer, minor repair required.	N/A	E-b
3	Greater than 1/32" wide crack, up to 4'0" long, major repair required.	14 Ft.	E-f
4	Greater than 1/32" wide crack, 4'-0" or longer, major repair required.	18 Ft.	E-g
5	1" to 4" diameter form tie spall, corroded reinforcement exposed, patched or unpatched.	17 Ea.	F-a
6	Unpatched spall 4" to 8" in diameter.	N/A	G-a
7	Patched spall due to corroded reinforcement, 4" to 8" in diameter.	5 Ea.	G-e
8	Patched spall due to corroded reinforcement, 8" to 15" in diameter, on beam over columns.	N/A	G-b
9	Patched spall due to corroded reinforcement, 8" to 24" in diameter.	16 Ea.	G-g
10	Beam soffit cracks, discoloration and deterioration.	9 $Ft.^2$	G-c
11	Scaling and delamination of concrete surface coating.	Entire Surface	H-b
12	Cracking and water leakage at wall grate.	N/A	E-h
13	Cracking and spalling around pipe.	1 Ea.	G-d
14	Large spall area above first floor entry.	1 Ea.	G-f
15	Horizontal patched crack in parapet	N/A	E-j
16	Vertical patched crack in second floor wall	N/A	E-j

* See Part III

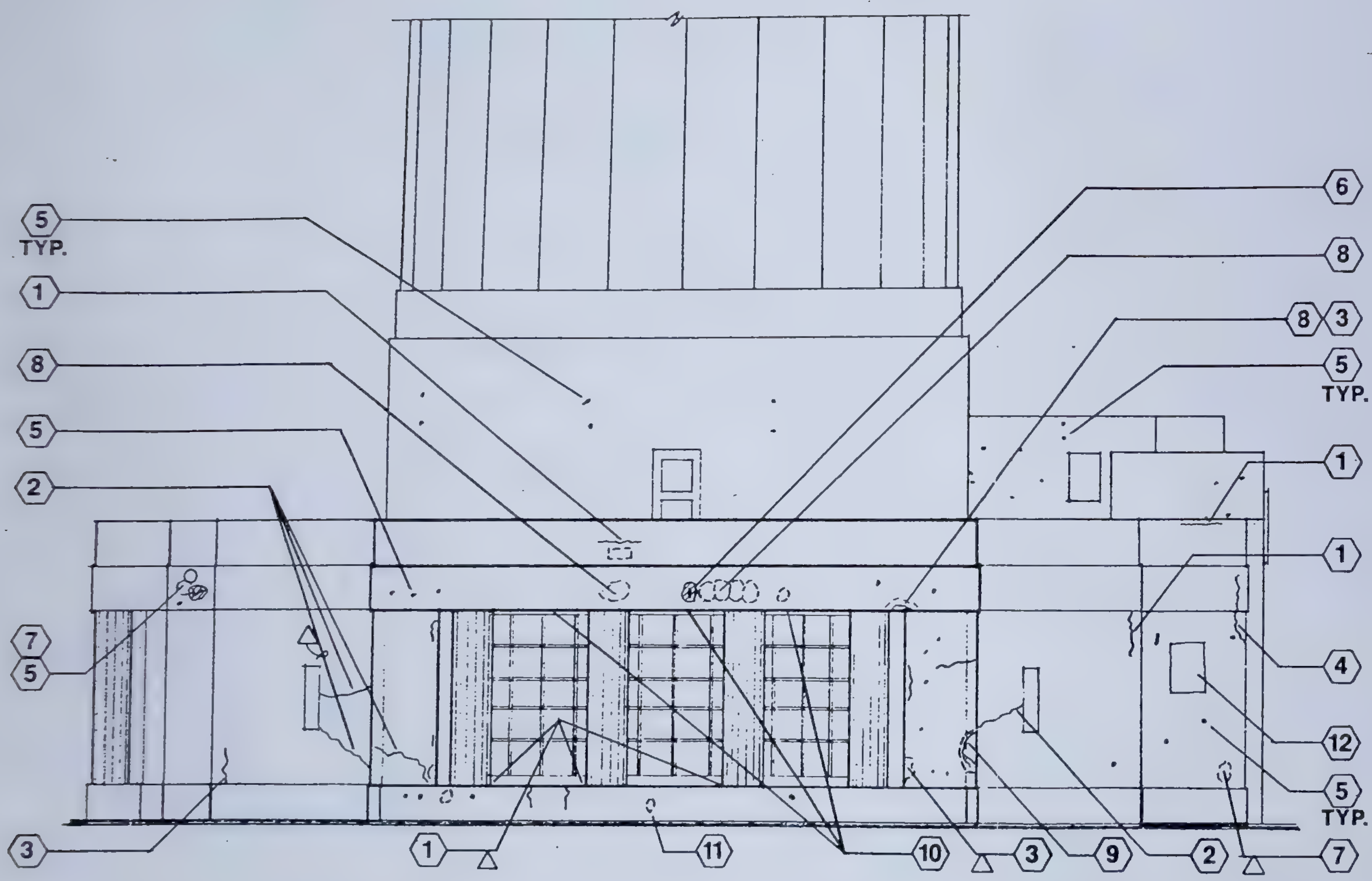


2 EAST ELEVATION

△ Photo referenced in Deter

ʌSE WALL DETERIORATION SURVEY TABLE
EAST ELEVATION

ıion	Quantity	Sect.-Photo*
n 1/32" wide crack, up to ng, minor repair required.	44 Ft.	E-c
n 1/32" wide crack, 4'-0" r, minor repair required.	30 Ft.	E-b
than 1/32" wide crack, up long, major repair re-	10 Ft.	E-f
than 1/32" wide crack, longer, major repair re-	6 Ft.	E-g
diameter form tie spall, reinforcement exposed, or unpatched.	37 Ea.	F-a
spall 4" to 8" in	2 Ea.	G-a
spall due to corroded ment, 4" to 8" in	4 Ea.	G-e
spall due to corroded ment, 8" to 15" in on beam over columns.	7 Ea.	G-b
spall due to corroded re- nt, 8" to 24" in	N/A	G-g
lt cracks, discolora- deterioration.	40 Ft.[2]	G-c
nd delamination of surface coating.	Entire Surface	H-b
and water leakage at wall	1 Ea.	E-h
and spalling around pipe.	N/A	G-d
ll area above first floor	N/A	G-f
patched crack in parapet	N/A	E-j
patched crack in second	N/A	E-j



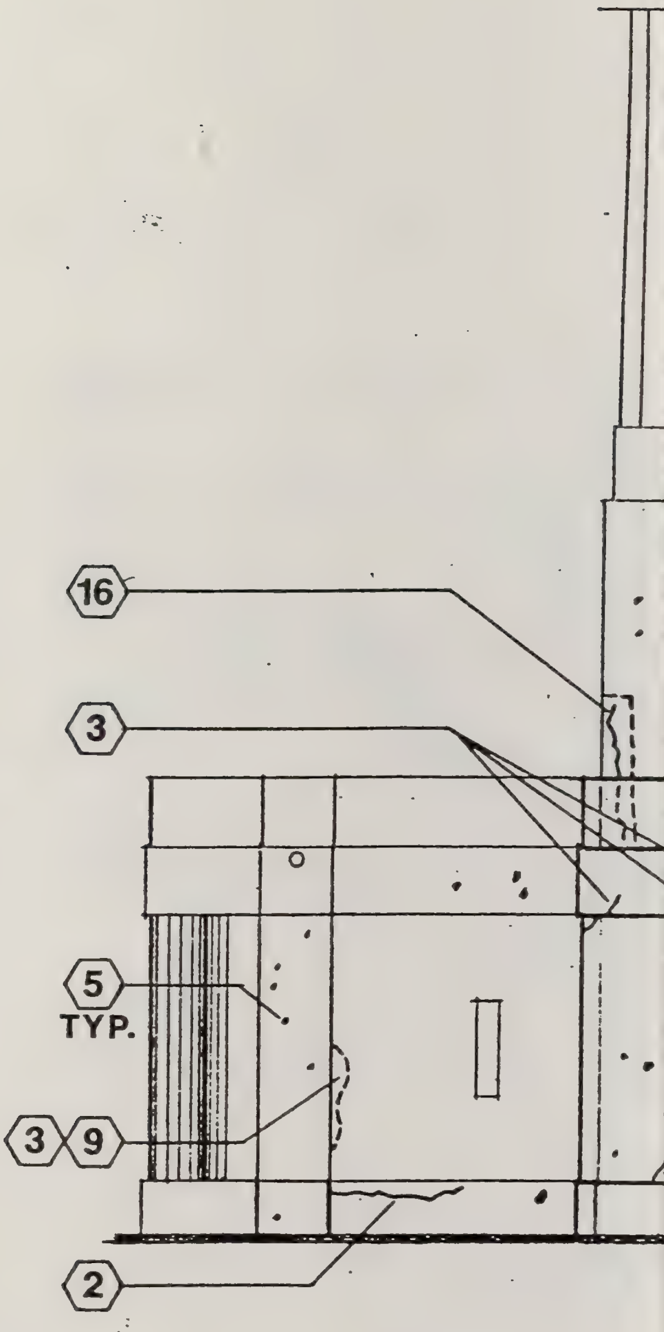
2 EAST ELEVATION - BASE

△ Photo referenced in Deterioration Survey Table is of this area.

BASE WALL DETERIORATION SURVEY TABLE
EAST ELEVATION

Item	Description	Quantity	Sect.-Photo*
1	Less than 1/32" wide crack, up to 4'-0" long, minor repair required.	44 Ft.	E-c
2	Less than 1/32" wide crack, 4'-0" or longer, minor repair required.	30 Ft.	E-b
3	Greater than 1/32" wide crack, up to 4'0" long, major repair required.	10 Ft.	E-f
4	Greater than 1/32" wide crack, 4'-0" or longer, major repair required.	6 Ft.	E-g
5	1" to 4" diameter form tie spall, corroded reinforcement exposed, patched or unpatched.	37 Ea.	F-a
6	Unpatched spall 4" to 8" in diameter.	2 Ea.	G-a
7	Patched spall due to corroded reinforcement, 4" to 8" in diameter.	4 Ea.	G-e
8	Patched spall due to corroded reinforcement, 8" to 15" in diameter, on beam over columns.	7 Ea.	G-b
9	Patched spall due to corroded reinforcement, 8" to 24" in diameter.	N/A	G-g
10	Beam soffit cracks, discoloration and deterioration.	40 $Ft.^2$	G-c
11	Scaling and delamination of concrete surface coating.	Entire Surface	H-b
12	Cracking and water leakage at wall grate.	1 Ea.	E-h
13	Cracking and spalling around pipe.	N/A	G-d
14	Large spall area above first floor entry.	N/A	G-f
15	Horizontal patched crack in parapet	N/A	E-j
16	Vertical patched crack in second floor wall	N/A	E-j

* See Part III

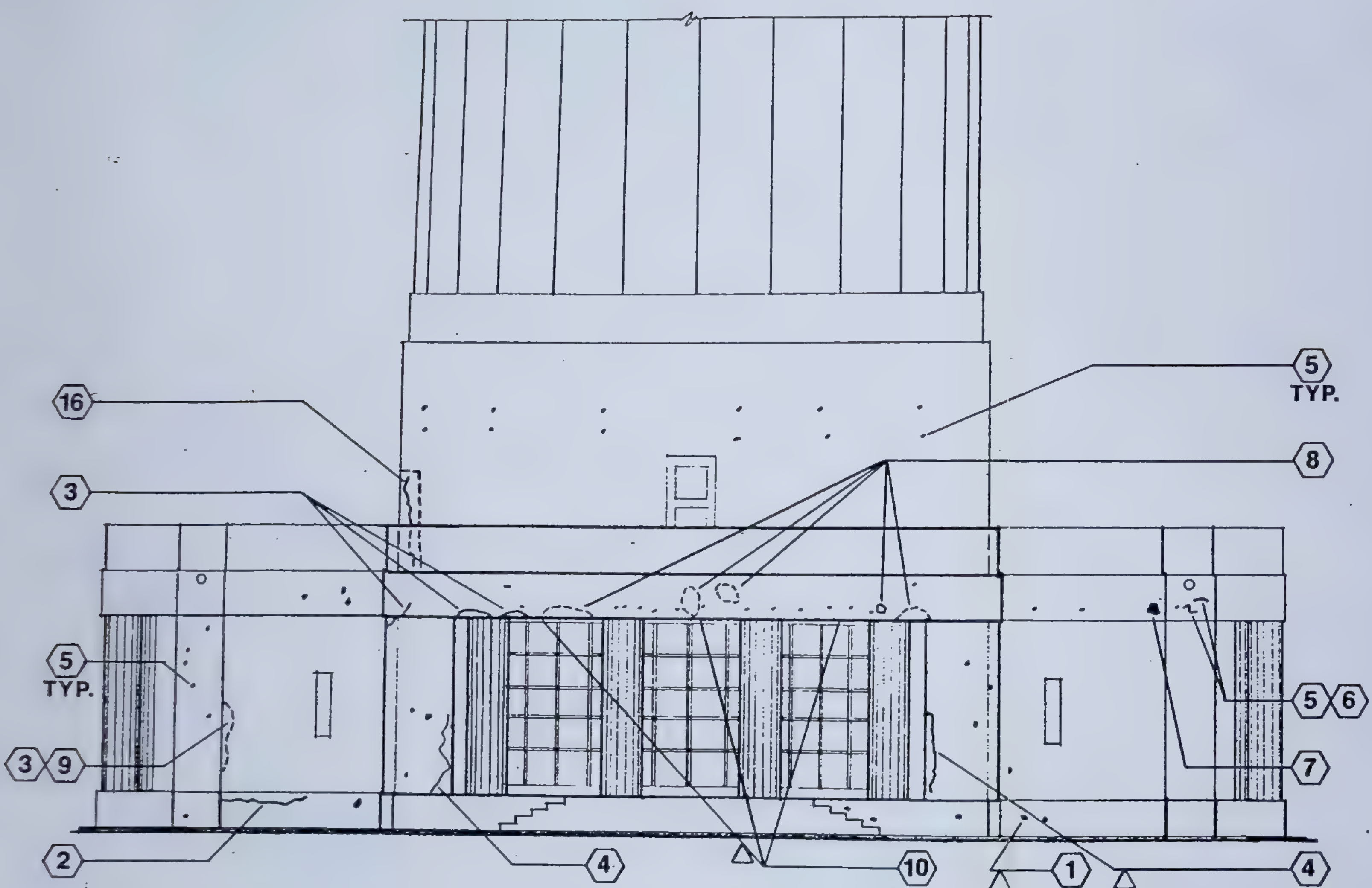


3 SOUTH ELEVATI

△ Photo referenced in De

ASE WALL DETERIORATION SURVEY TABLE
SOUTH ELEVATION

tion	Quantity	Sect.-Photo*
an 1/32" wide crack, up to ong, minor repair required.	N/A	E-c
an 1/32" wide crack, 4'-0" er, minor repair required.	6 Ft.	E-b
than 1/32" wide crack, up long, major repair re-	15 Ft.	E-f
than 1/32" wide crack, longer, major repair re-	12 Ft.	E-g
diameter form tie spall reinforcement exposed, or unpatched.	53 Ea.	F-a
d spall 4" to 8" in .	1 Ea.	G-a
spall due to corroded ement, 4" to 8" in .	1 Ea.	G-e
spall due to corroded ement, 8" to 15" in , on beam over columns.	7 Ea.	G-b
spall due to corroded re- ent, 8" to 24" in .	1 Ea.	G-g
fit cracks, discolora- deterioration.	40 Ft.[2]	G-c
and delamination of surface coating.	Entire Surface	H-b
and water leakage at wall	N/A	E-j
and spalling around pipe.	N/A	G-d
all area above first floor	N/A	G-f
l patched crack in parapet	N/A	E-j
patched crack in second l	7 Ft.	E-j



3 SOUTH ELEVATION – BASE

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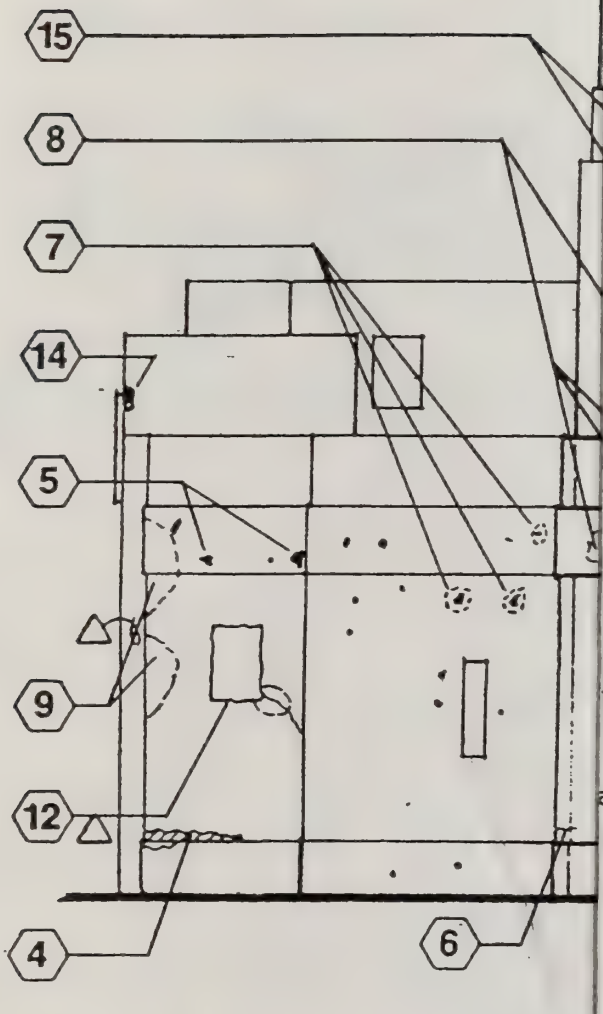
BASE WALL DETERIORATION SURVEY TABLE
SOUTH ELEVATION

Item	Description	Quantity	Sect.-Photo*
1	Less than 1/32" wide crack, up to 4'-0" long, minor repair required.	N/A	E-c
2	Less than 1/32" wide crack, 4'-0" or longer, minor repair required.	6 Ft.	E-b
3	Greater than 1/32" wide crack, up to 4'0" long, major repair required.	15 Ft.	E-f
4	Greater than 1/32" wide crack, 4'-0" or longer, major repair required.	12 Ft.	E-g
5	1" to 4" diameter form tie spall corroded reinforcement exposed, patched or unpatched.	53 Ea.	F-a
6	Unpatched spall 4" to 8" in diameter.	1 Ea.	G-a
7	Patched spall due to corroded reinforcement, 4" to 8" in diameter.	1 Ea.	G-e
8	Patched spall due to corroded reinforcement, 8" to 15" in diameter, on beam over columns.	7 Ea.	G-b
9	Patched spall due to corroded reinforcement, 8" to 24" in diameter.	1 Ea.	G-g
10	Beam soffit cracks, discoloration and deterioration.	40 $Ft.^2$	G-c
11	Scaling and delamination of concrete surface coating.	Entire Surface	H-b
12	Cracking and water leakage at wall grate.	N/A	E-j
13	Cracking and spalling around pipe.	N/A	G-d
14	Large spall area above first floor entry.	N/A	G-f
15	Horizontal patched crack in parapet	N/A	E-j
16	Vertical patched crack in second floor wall	7 Ft.	E-j

* See Part III

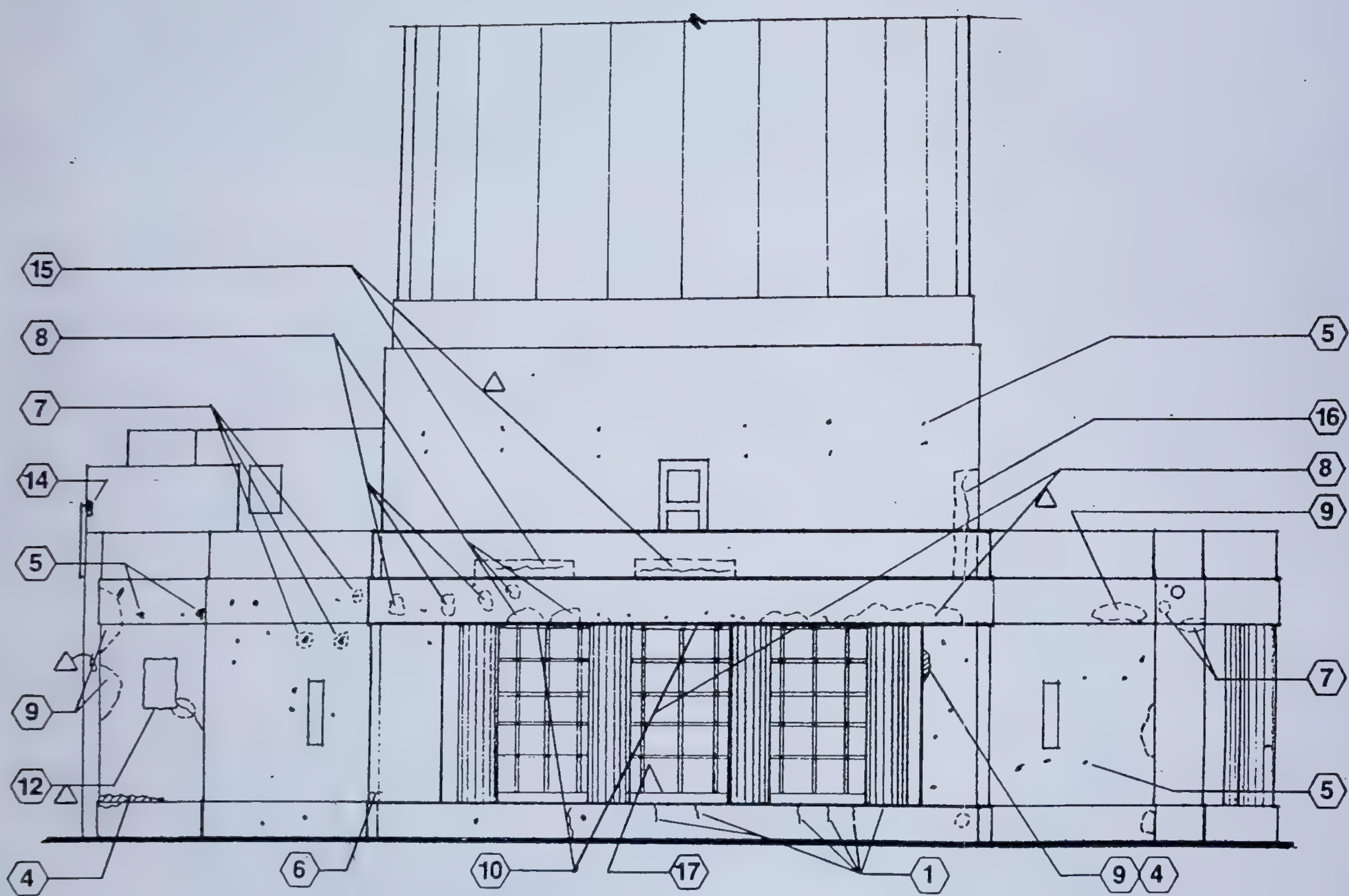
ASE WALL DETERIORATION SURVEY TABLE
WEST ELEVATION

tion	Quantity	Sect.-Photo*
an 1/32" wide crack, up to ong, minor repair required.	10 Ft.	E-c
an 1/32" wide crack, 4'-0" er, minor repair required.	N/A	E-b
than 1/32" wide crack, up long, major repair re-	N/A	E-f
than 1/32" wide crack, longer, major repair re-	16 Ft.	E-g
" diameter form tie spall, reinforcement exposed, or unpatched.	50	F-a
d spall 4" to 8" in .	1 Ea.	G-a
spall due to corroded ement, 4" to 8" in .	8 Ea.	G-e
spall due to corroded ement, 8" to 15" in , on beam over columns.	10 Ea.	G-b
spall due to corroded re- ent, 8" to 24" in .	6 Ea.	G-g
fit cracks, discolora- deterioration.	40 Ft.[2]	G-c
and delamination of surface coating.	Entire Surface	H-b
and water leakage at wall	1 Ea.	E-h
and spalling around pipe.	N/A	G-d
ll area above first floor	1 Ea.	G-f
l patched crack in parapet	12 Ft.	E-j
patched crack in second l	7 Ft.	E-j
lobby floor	15 Ft.	K-a



4 WEST ELEVATIO

△ Photo referenced in De



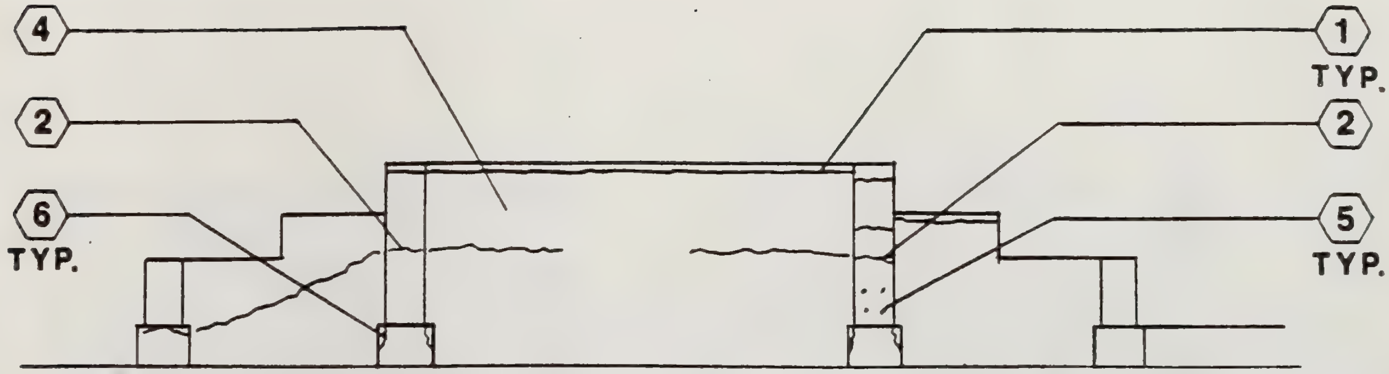
4 WEST ELEVATION - BASE

△ Photo referenced in Deterioration Survey Table is of this area.

BASE WALL DETERIORATION SURVEY TABLE
WEST ELEVATION -

Item	Description	Quantity	Sect.-Photo*
1	Less than 1/32" wide crack, up to 4'-0" long, minor repair required.	10 Ft.	E-c
2	Less than 1/32" wide crack, 4'-0" or longer, minor repair required.	N/A	E-b
3	Greater than 1/32" wide crack, up to 4'0" long, major repair required.	N/A	E-f
4	Greater than 1/32" wide crack, 4'-0" or longer, major repair required.	16 Ft.	E-g
5	1" to 4" diameter form tie spall, corroded reinforcement exposed, patched or unpatched.	50	F-a
6	Unpatched spall 4" to 8" in diameter.	1 Ea.	G-a
7	Patched spall due to corroded reinforcement, 4" to 8" in diameter.	8 Ea.	G-e
8	Patched spall due to corroded reinforcement, 8" to 15" in diameter, on beam over columns.	10 Ea.	G-b
9	Patched spall due to corroded reinforcement, 8" to 24" in diameter.	6 Ea.	G-g
10	Beam soffit cracks, discoloration and deterioration.	40 Ft.^{2}	G-c
11	Scaling and delamination of concrete surface coating.	Entire Surface	H-b
12	Cracking and water leakage at wall grate.	1 Ea.	E-h
13	Cracking and spalling around pipe.	N/A	G-d
14	Large spall area above first floor entry.	1 Ea.	G-f
15	Horizontal patched crack in parapet	12 Ft.	E-j
16	Vertical patched crack in second floor wall	7 Ft.	E-j
17	Crack at lobby floor	15 Ft.	K-a

* See Part III



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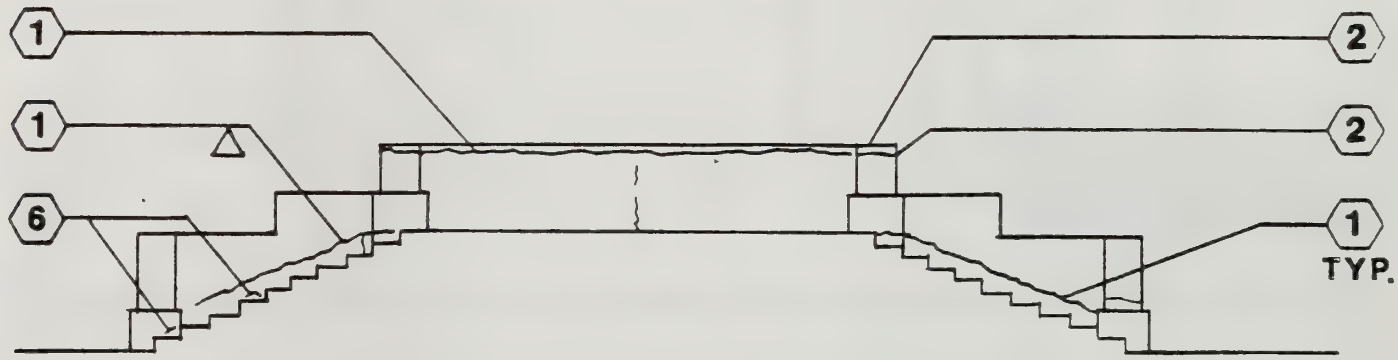

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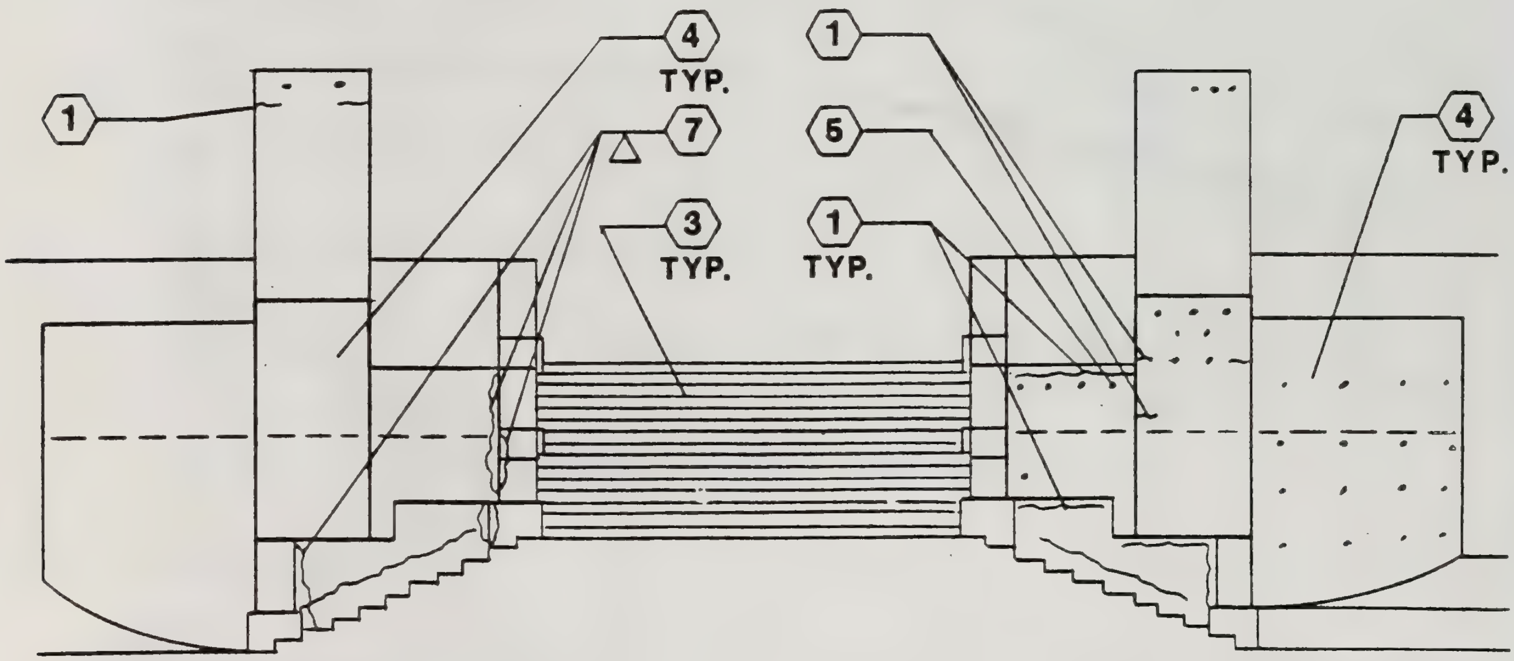
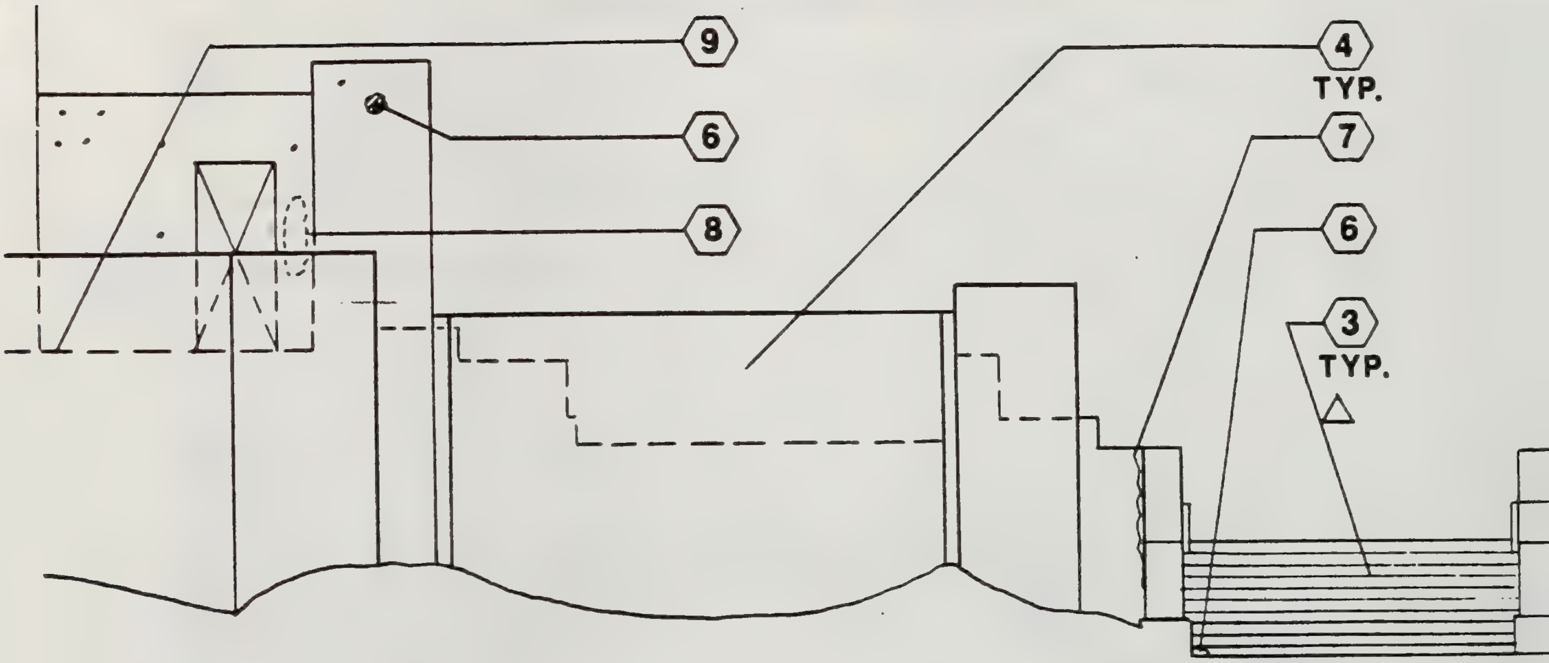


7

Note: For Deterioration Survey Table, see page A-8

△ Photo referenced in Table is of this area.

Exhibit CC



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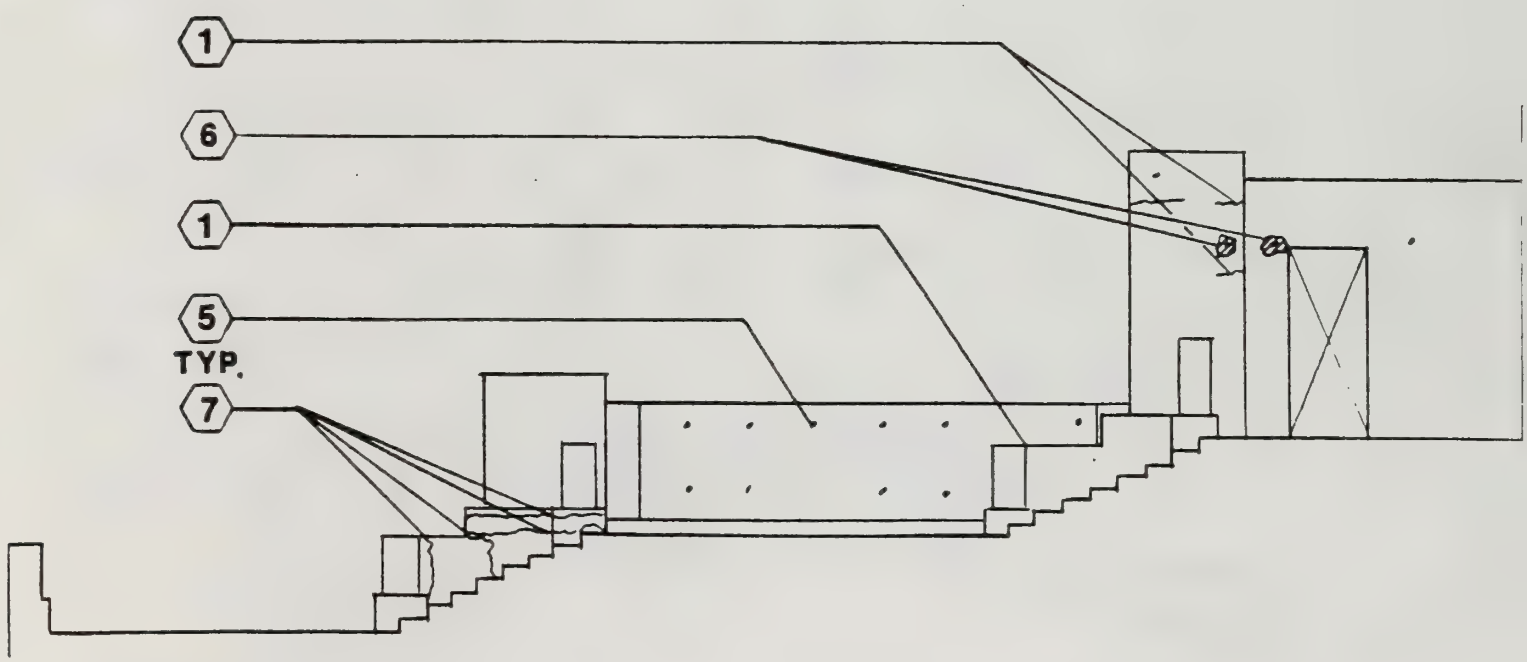
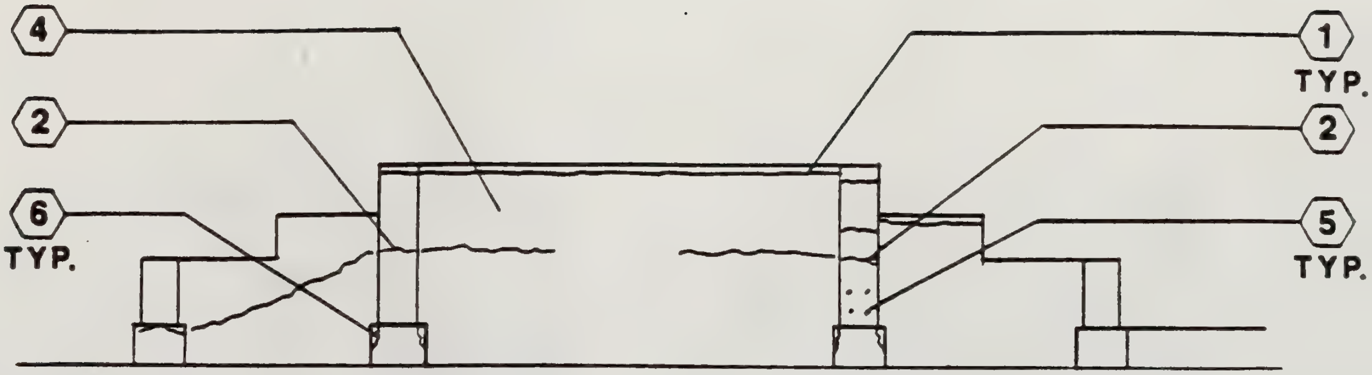


9

Note: For Deterioration Survey Table, see page A-8

△ Photo referenced in Table is of this area.



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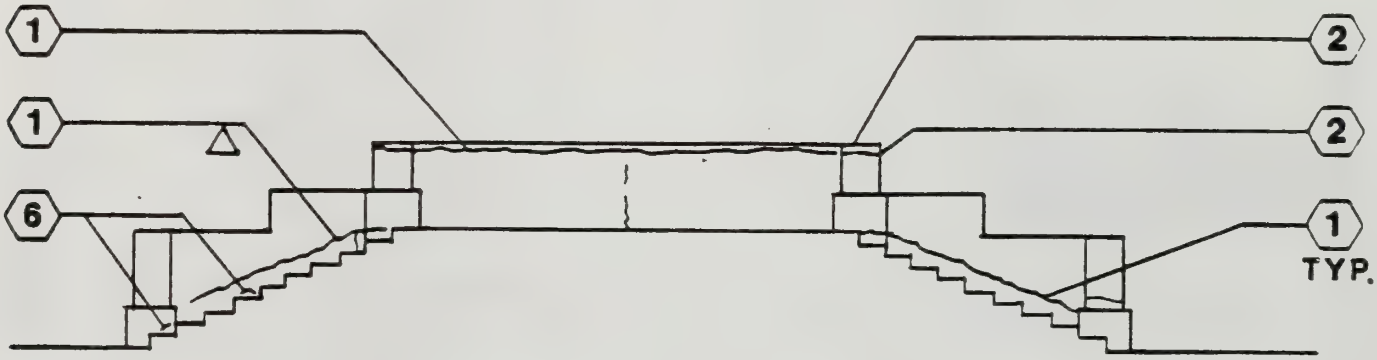

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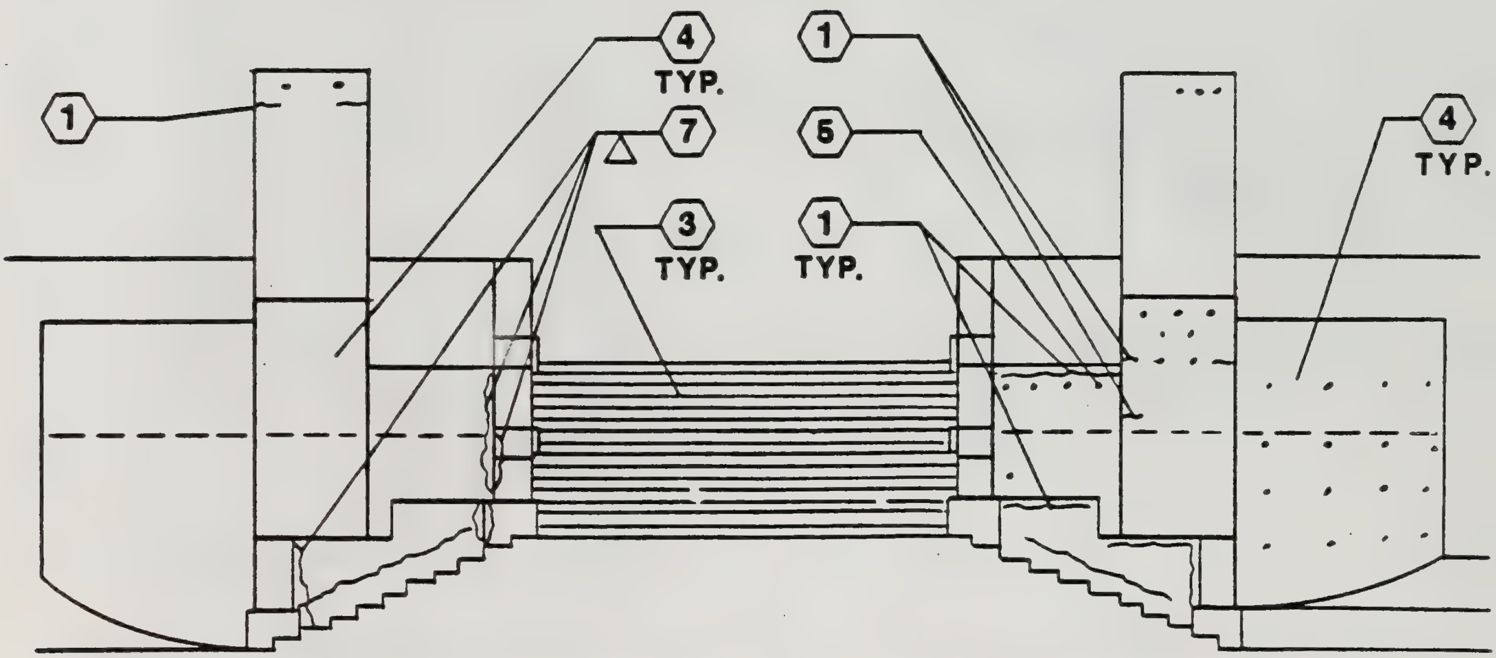

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Note: For Deterioration Survey Table, see page A-8

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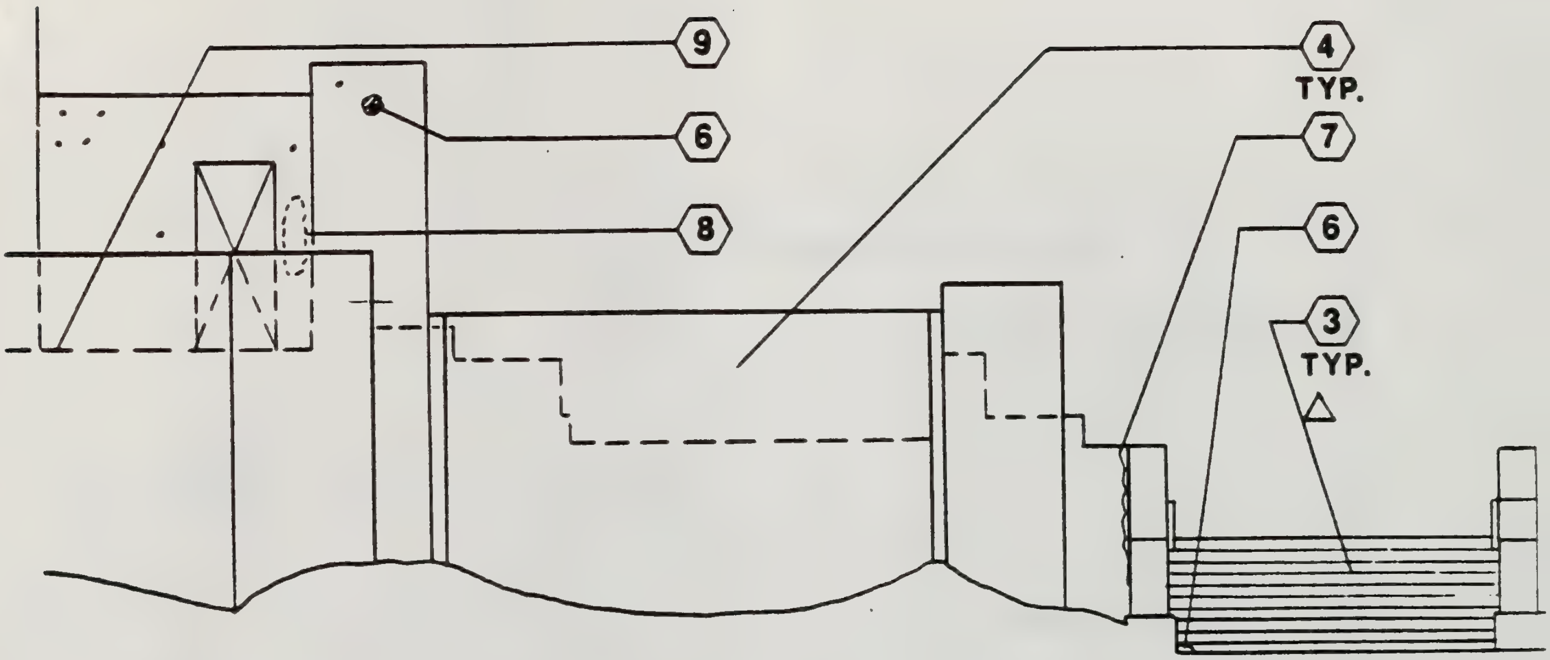

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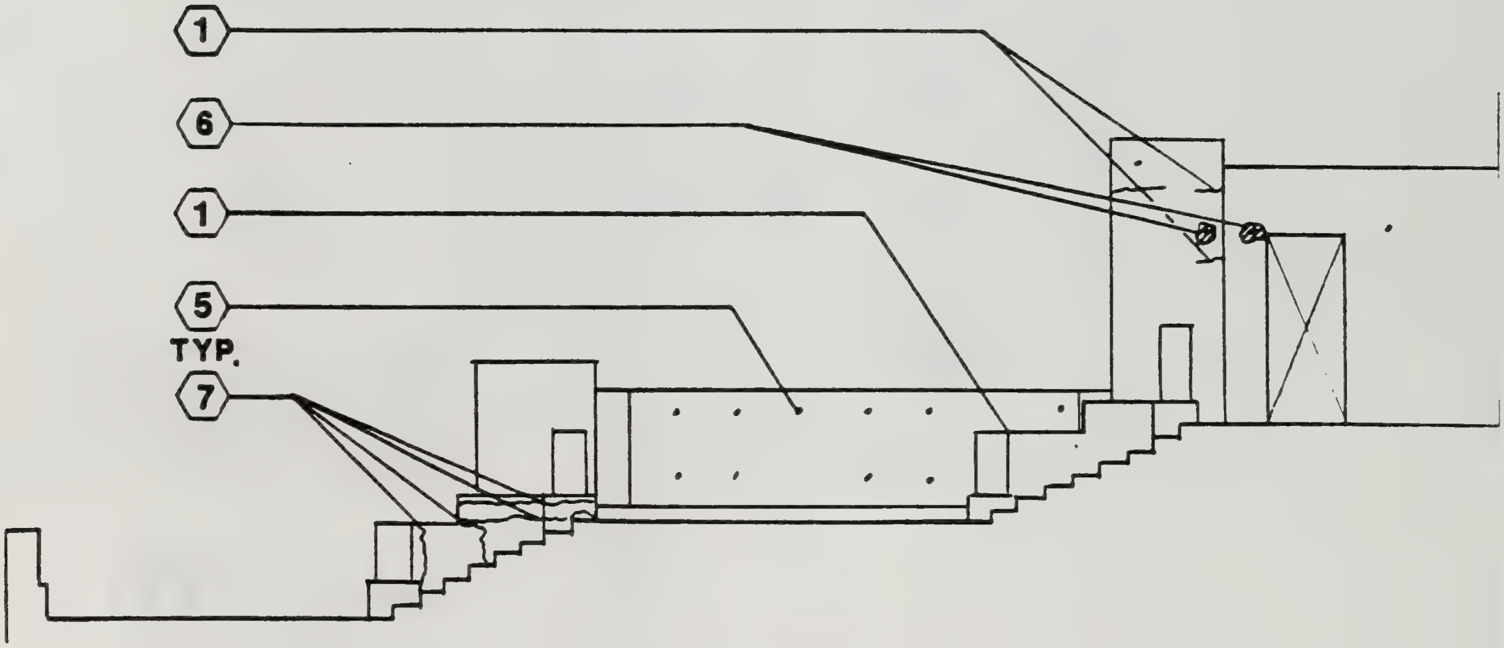
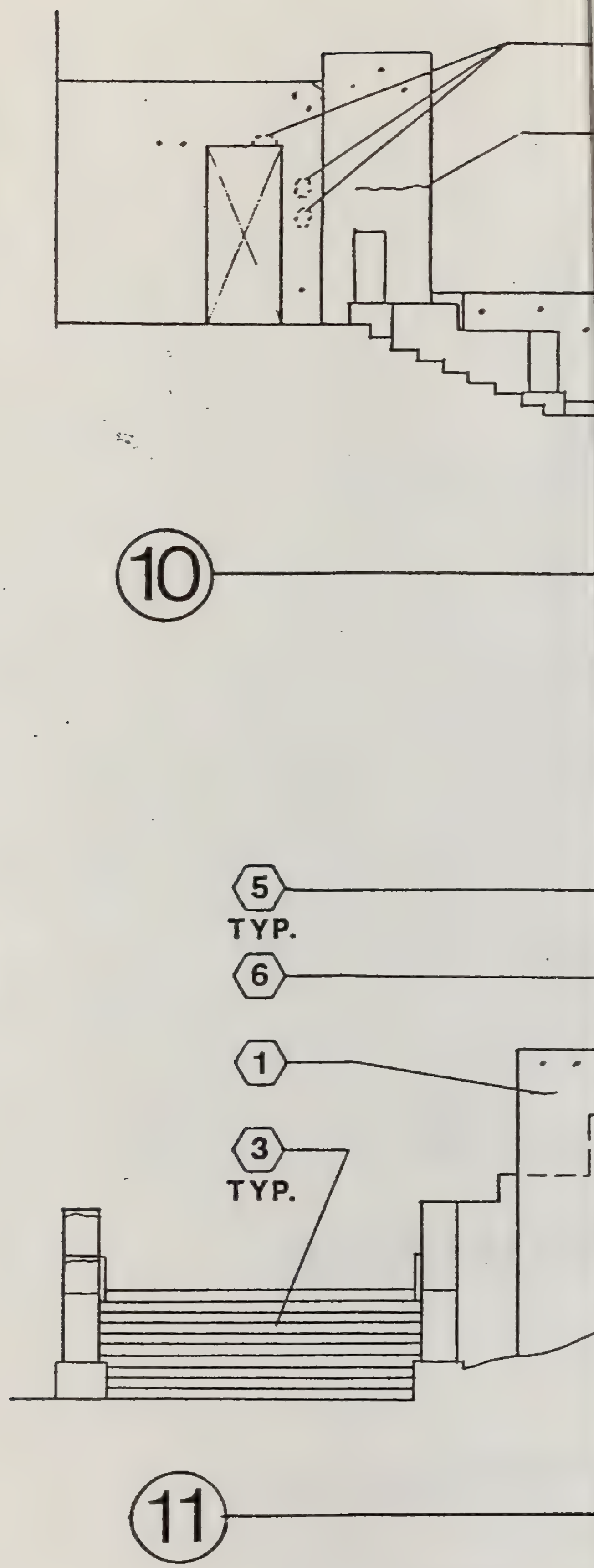


9

Note: For Deterioration Survey Table, see page A-8

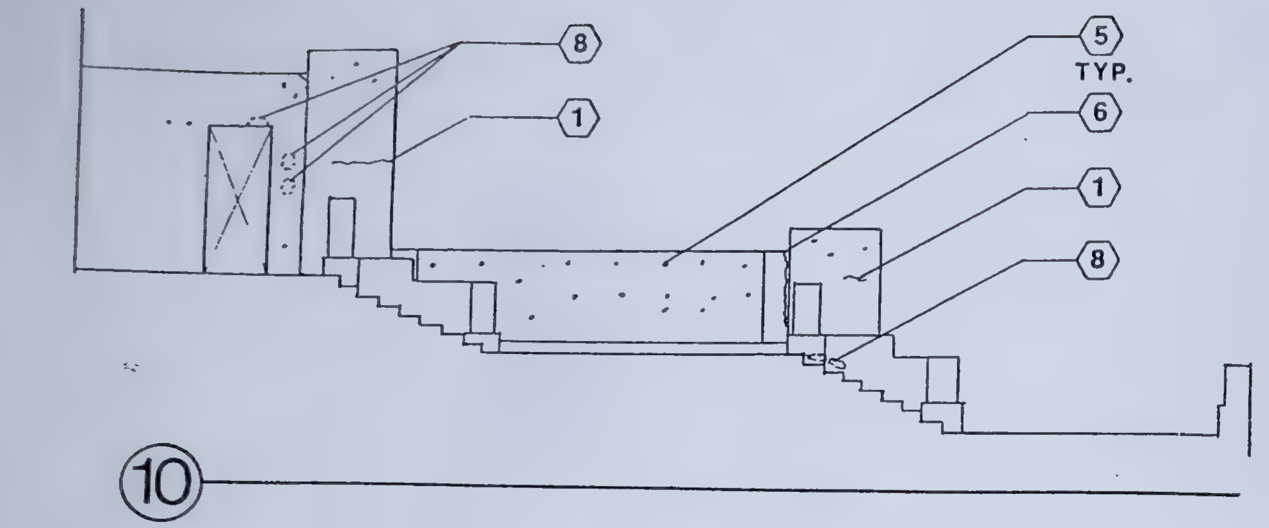
△ Photo referenced in Table is of this area.

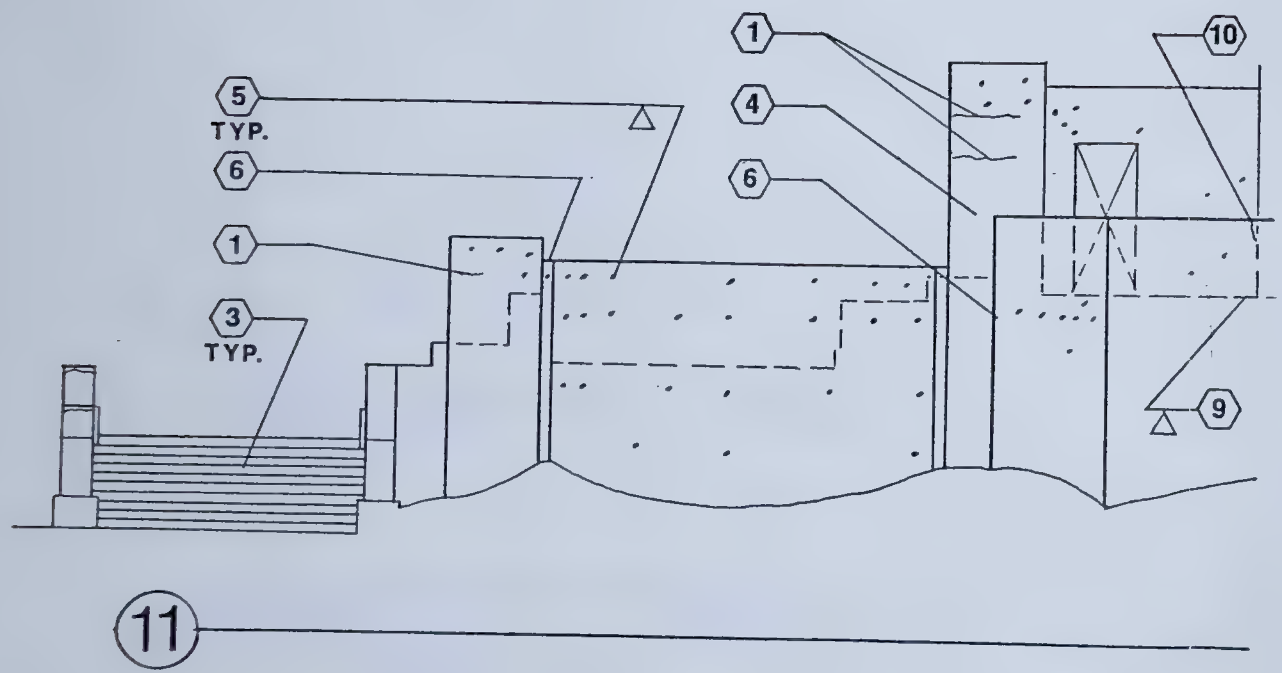


ETERIORATION SURVEY TABLE

	Quantity	Sect.-Photo*
crack.	Typ. Cond.	E-c
ide crack. d.	40 Ft.	E-f
and	Typ. Cond.	E-m
ation of ting.	Entire Surface	H-b
rm tie spall, nt exposed.	133 Ea.	F-a
to 8" in	13 Ea.	G-a
palls at wall.	5 Ea.	M-a
corroded 24" in	7 Ea.	G-g
ent of	Approx. 1000 Ft.^{2}	M-b
ining wall	Location	M-b

△ Photo referenced

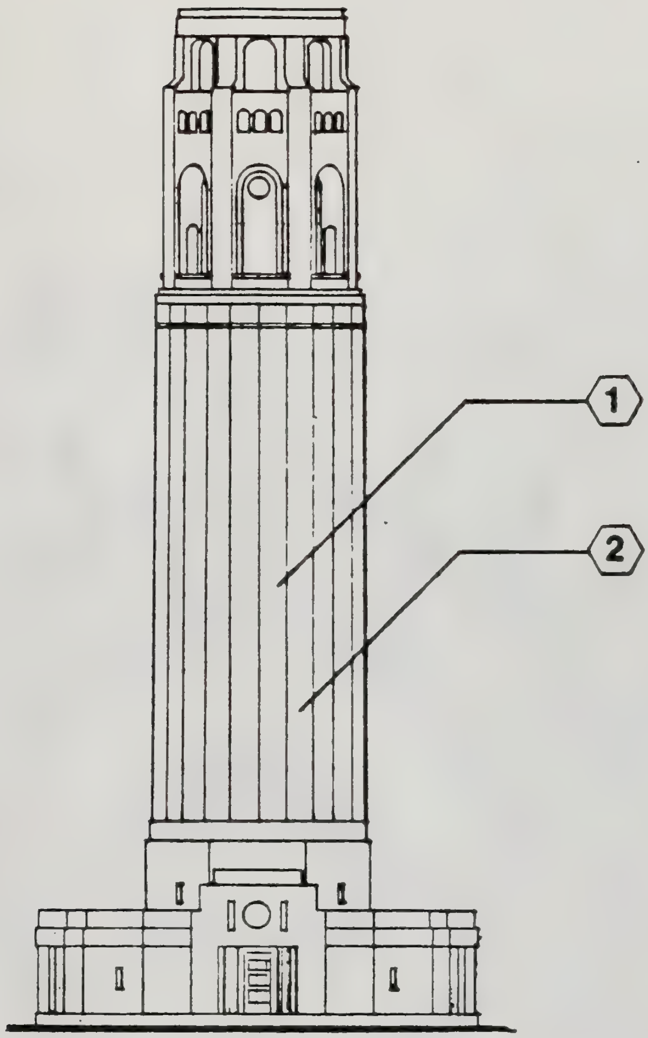




ENTRY WALLS DETERIORATION SURVEY TABLE

Item	Description	Quantity	Sect.-Photo*
1	Less than 1/32" wide crack. No repair required.	Typ. Cond.	E-c
2	Greater than 1/32" wide crack. Minor repair required.	40 Ft.	E-f
3	Minor stair cracking and spalling.	Typ. Cond.	E-m
4	Scaling and discoloration of concrete surface coating.	Entire Surface	H-b
5	1" to 4" diameter form tie spall, corroded reinforcement exposed.	133 Ea.	F-a
6	Unpatched spall, 4" to 8" in diameter	13 Ea.	G-a
7	Patched cracks and spalls at displaced retaining wall.	5 Ea.	M-a
8	Patched spall due to corroded reinforcement, 8" to 24" in diameter	7 Ea.	G-g
9	Cracking and settlement of walkway slab.	Approx. 1000 Ft.^{2}	M-b
10	Displacement of retaining wall	Location	M-b

△ Photo referenced in Deterioration Survey Table is of this area.

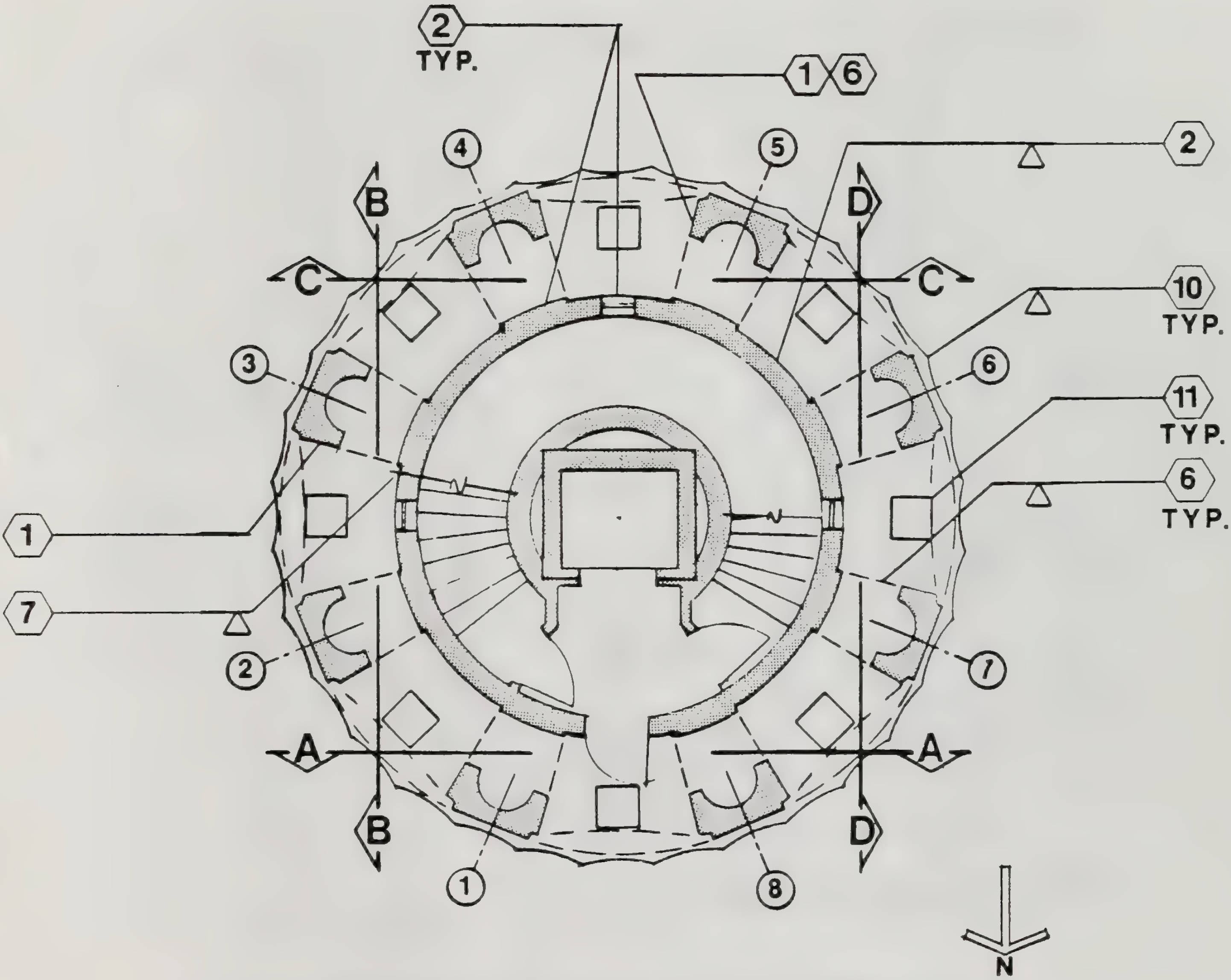


NORTH ELEVATION – TOWER

TOWER DETERIORATION SURVEY TABLE

Item	Description	Quantity	Sect.-Photo*
1	1" to 4" diameter form tie spall	Approx. 5000	F-b
2	Scaling and delamination of concrete surface coating.	Entire Surface	H-c

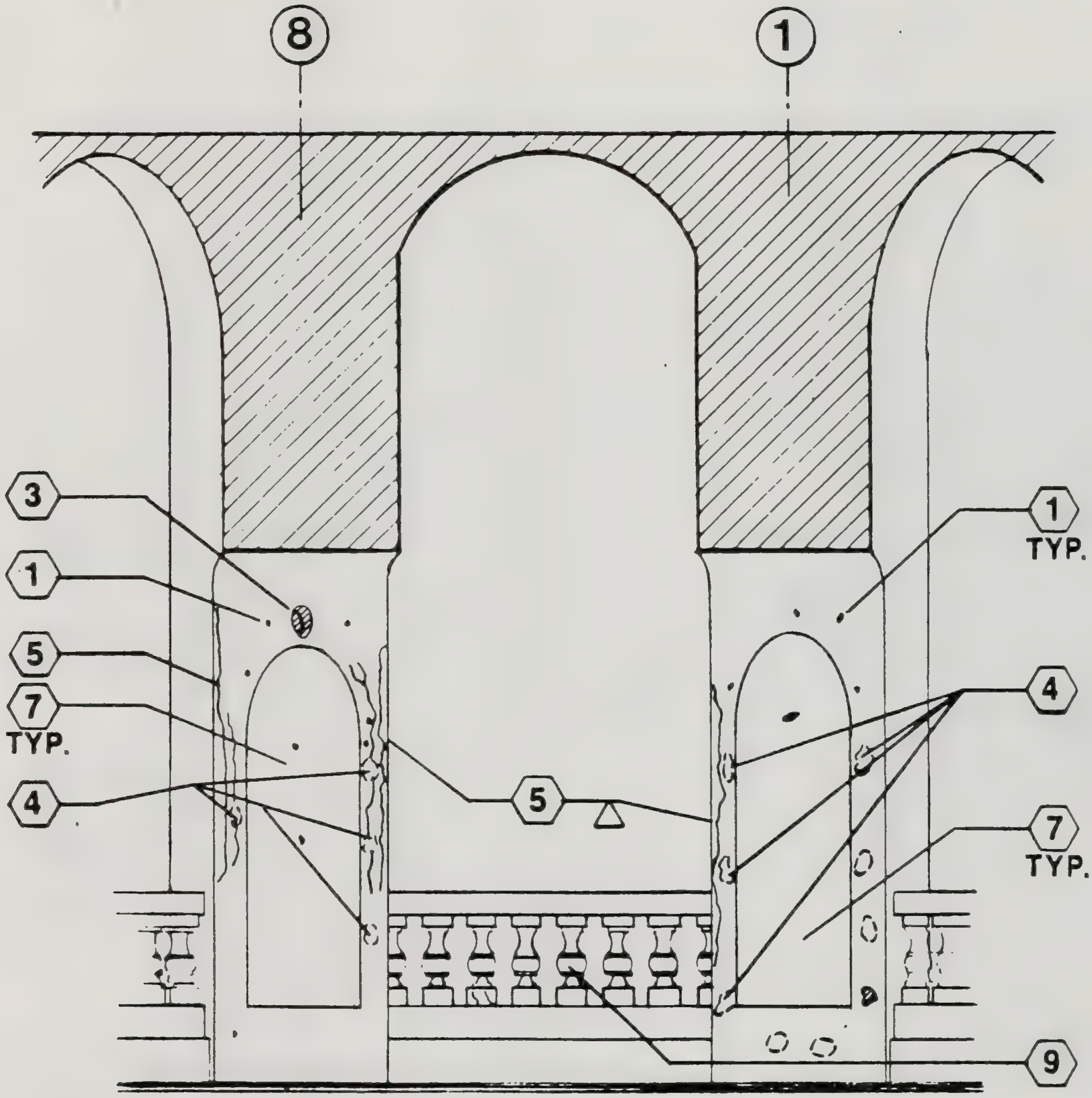
* See Part III



BELVEDERE LEVEL PLAN

Note: For Deterioration Survey Table, see page C5

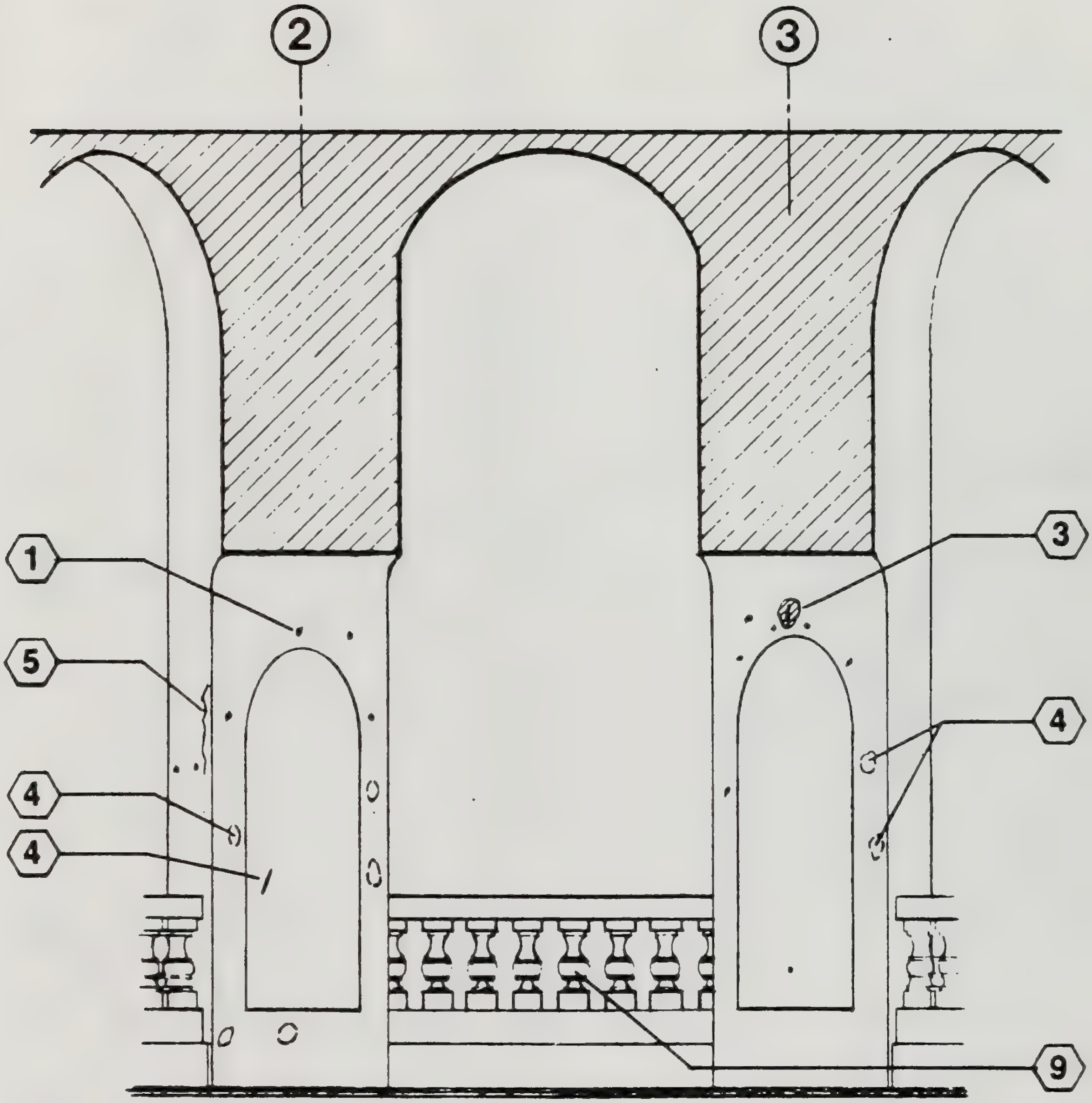
△ Photo referenced in Deterioration Survey Table is of this area.



A INTERIOR ELEVATION - BELVEDERE LEVEL

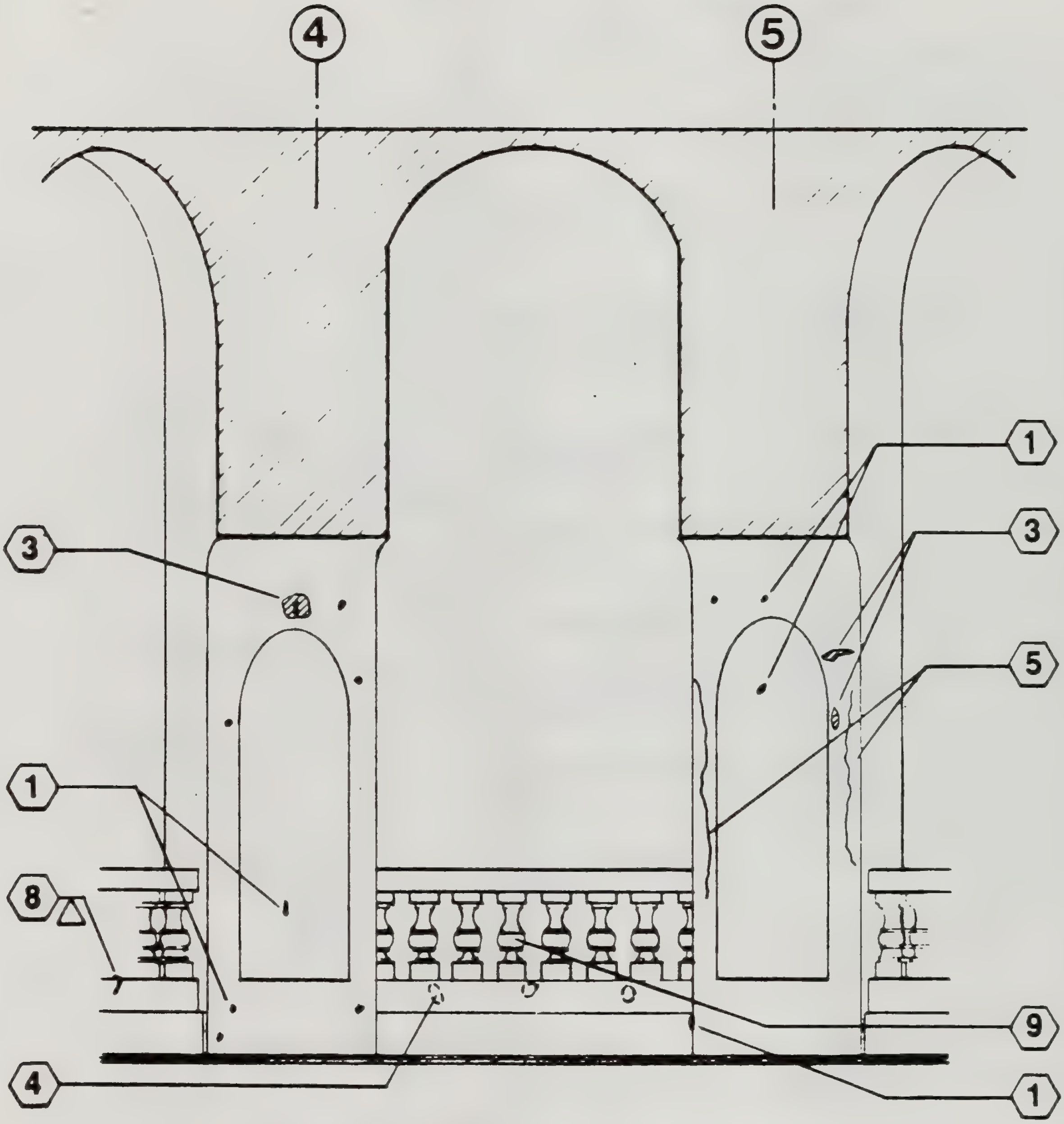
Note: For Deterioration Survey Table, see page C5

△ Photo referenced in Table is of this area.



B INTERIOR ELEVATION - BELVEDERE LEVEL

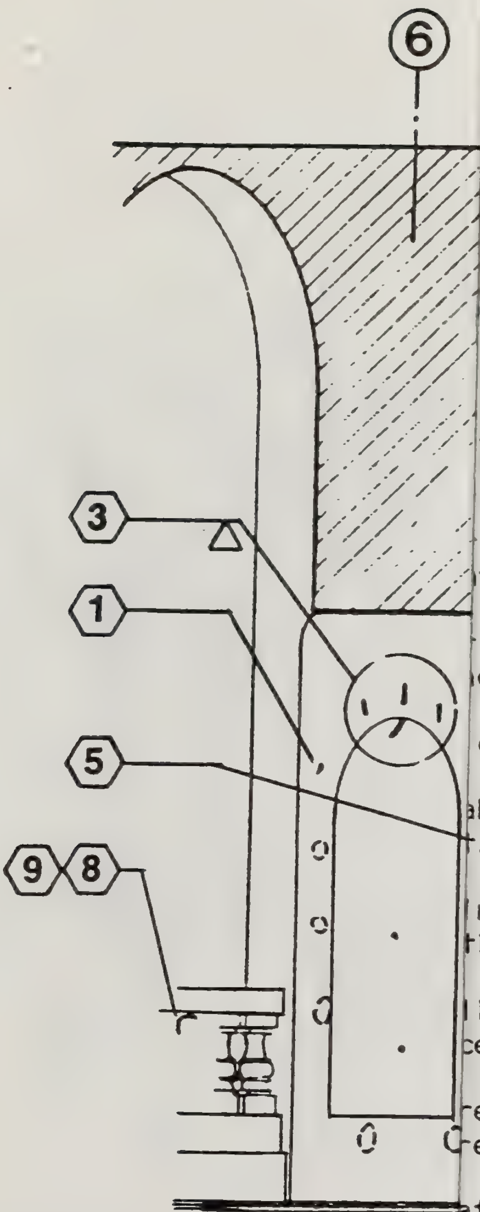
Note: For Deterioration Survey Table, see page C5



C INTERIOR ELEVATION - BELVEDERE LEVEL

Note: For Deterioration Survey Table, see page C5

△ Photo referenced in Table is of this area.

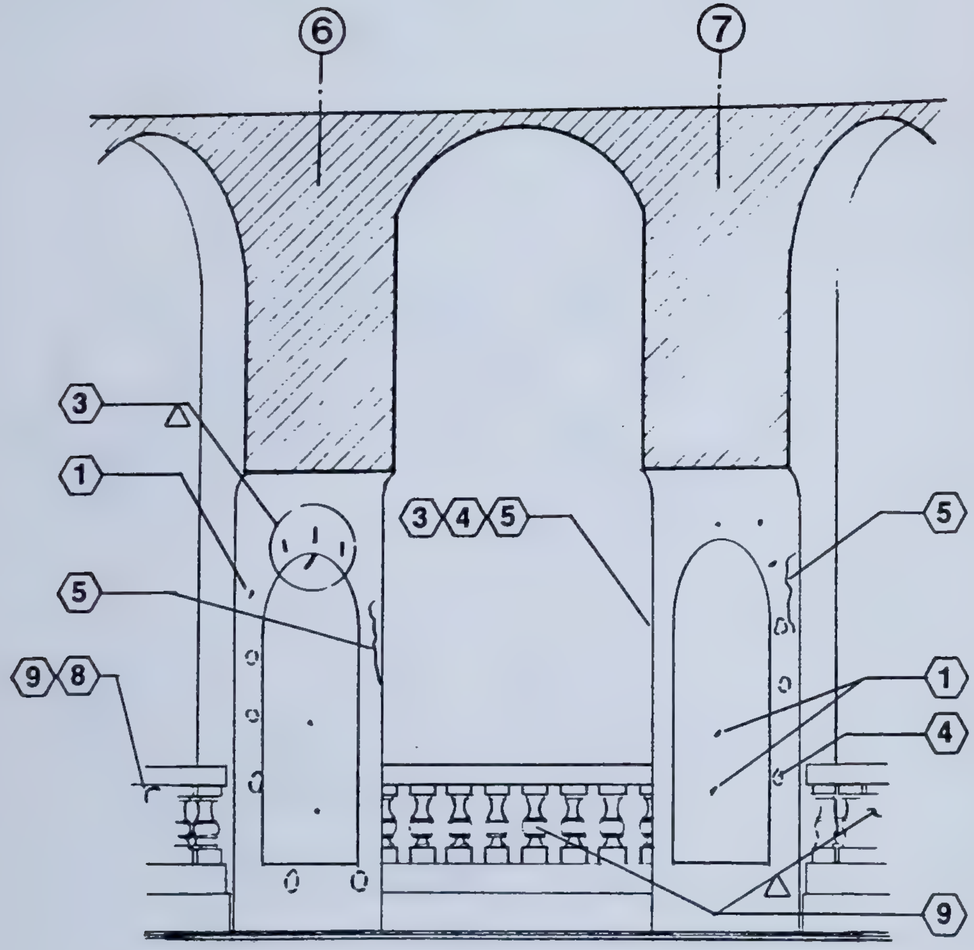


DINTER
BELV

DETERIORATION SURVEY TABLE

	Quantity	Sect-Photo*
form tie spall, atched or un-	45 Ea.	F-a
form tie spall wall, patched	Approx. 375 Ea.	F-b
spall, cor- t exposed.	10 Ea.	G-a
spall, patched ed.	31 Ea.	G-e
column corner.	105 Ft.	E-a
bove arches and . above floor	168 Ft.	E-e
nation of con- ting.	Entire Surface	H-a
ling @ exposed cement.	2 Ea.	J-b
re scaling and crete.	Typical Cond.	J-a
ation of orner	Typical Cond.	G-j

△ Photo referenc



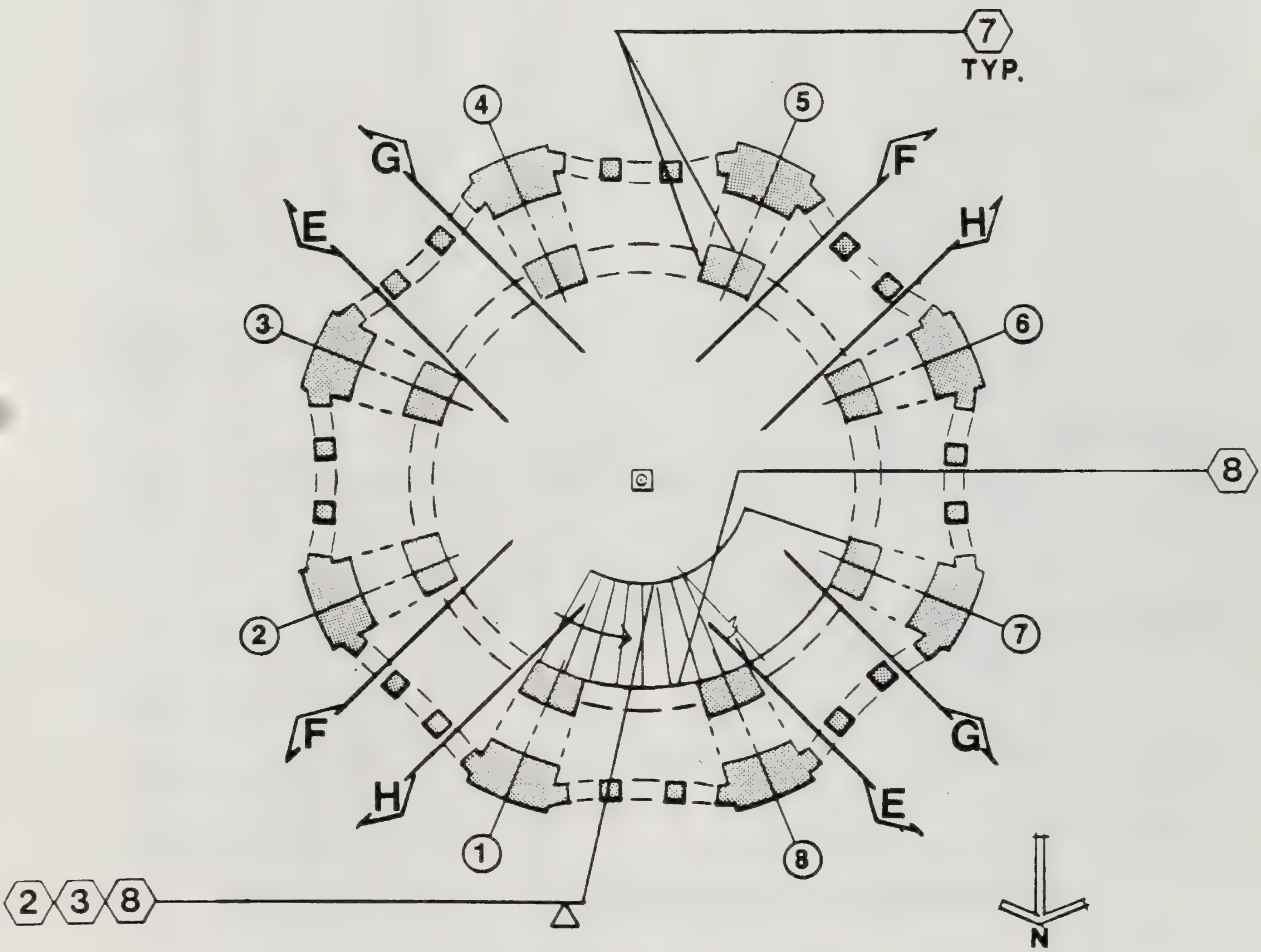
D INTERIOR ELEVATION – BELVEDERE LEVEL

△ Photo referenced in Deterioration Survey Table is of this area.

BELVEDERE LEVEL DETERIORATION SURVEY TABLE

Item	Description	Quantity	Sect-Photo*
1	1" to 4" diameter form tie spall, random location, patched or unpatched.	45 Ea.	F-a
2	1" to 4" diameter form tie spall pattern on inside wall, patched or unpatched.	Approx. 375 Ea.	F-b
3	4" to 12" diameter spall, corroded reinforcement exposed.	10 Ea.	G-a
4	4" to 12" diameter spall, patched or partially patched.	31 Ea.	G-e
5	Vertical crack at column corner.	105 Ft.	E-a
6	Horizontal crack above arches and inside wall, 10 Ft. above floor	168 Ft.	E-e
7	Scaling and delamination of concrete surface coating.	Entire Surface	H-a
8	Balustrade - spalling @ exposed corroding reinforcement.	2 Ea.	J-b
9	Balustrade - severe scaling and crumbling of concrete.	Typical Cond.	J-a
10	Scaling & Delamination of Exterior Fluted Corner	Typical Cond.	G-j

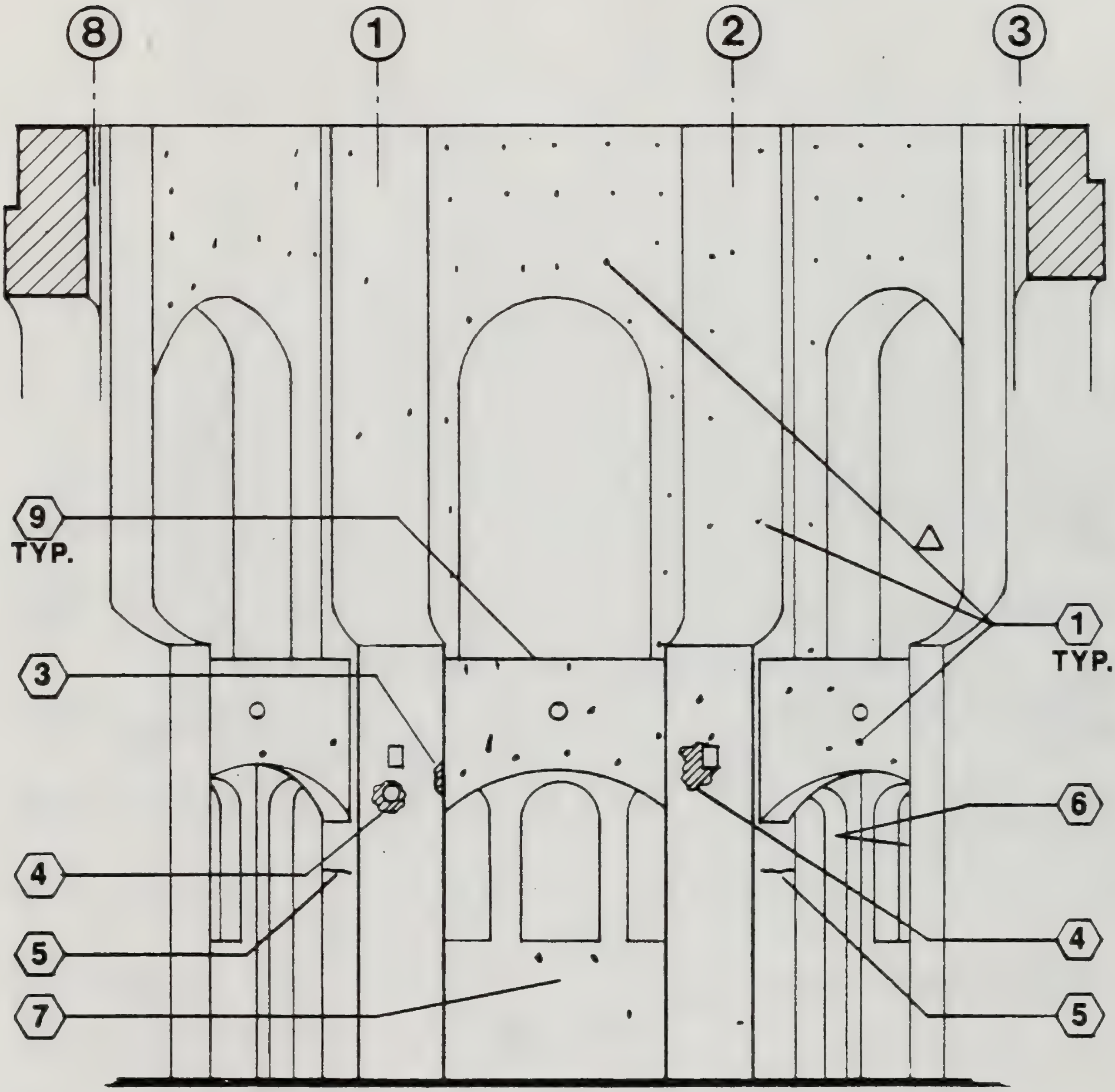
* See Part III



ROOF LEVEL PLAN

<u>Note</u>: For Deterioration Survey Table, see page D5

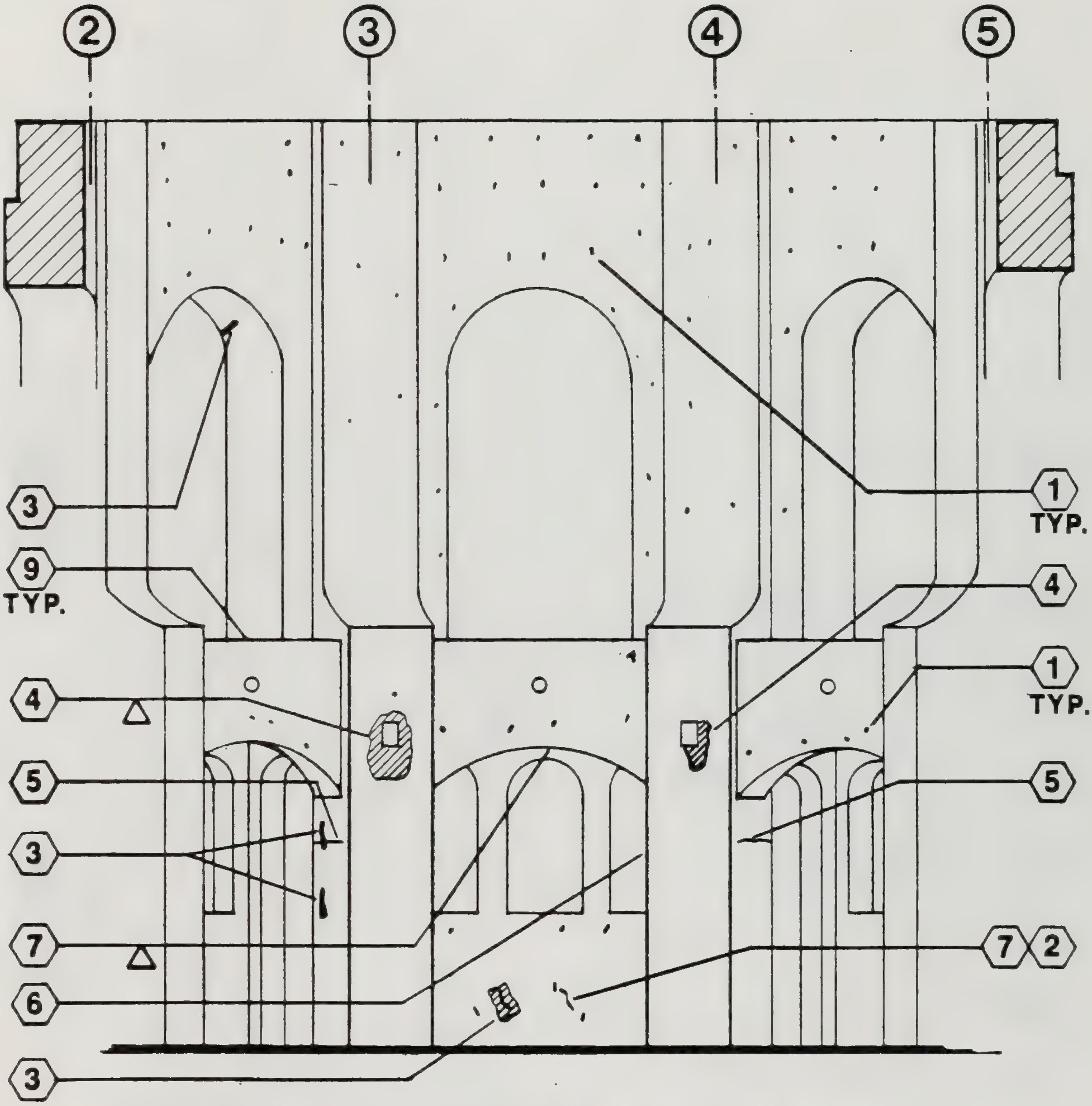
△ Photo referenced in Table is of this area.



E INTERIOR ELEVATION - ROOF LEVEL

Note: For Deterioration Survey Table, see page D5

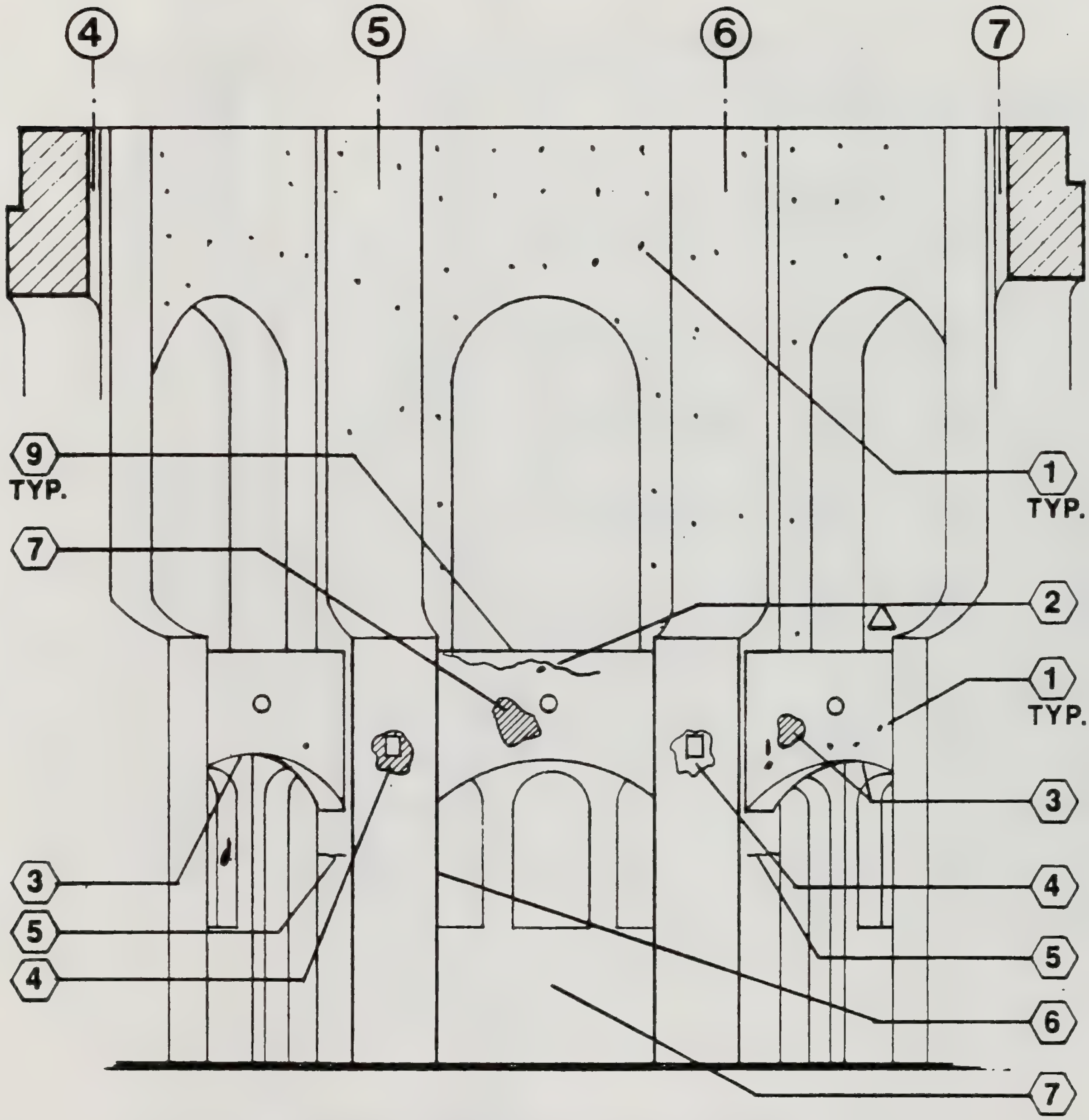
△ Photo referenced in Table is of this area.



F INTERIOR ELEVATION - ROOF LEVEL

Note: For Deterioration Survey Table, see page D5

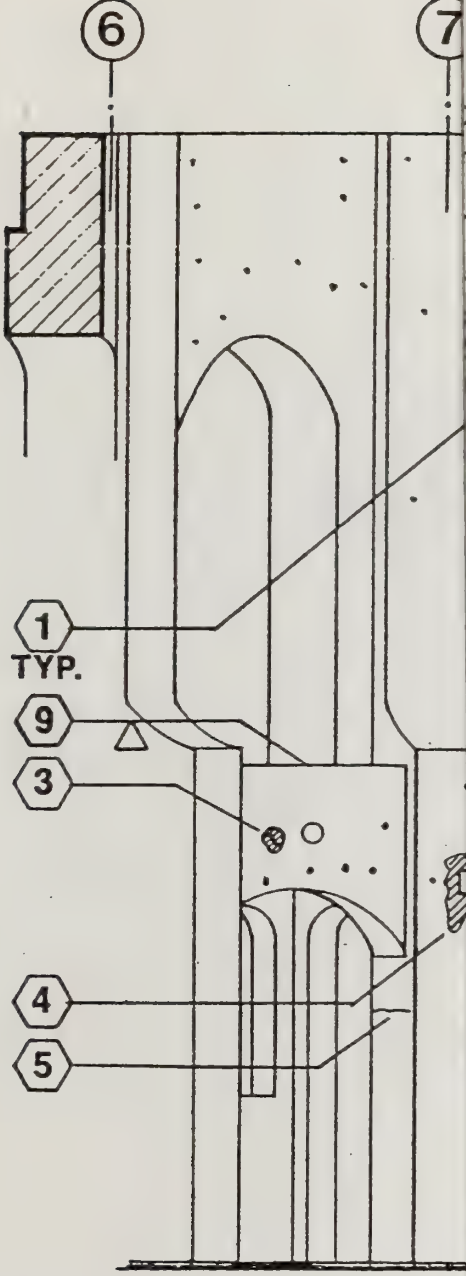
△ Photo referenced in Table is of this area.



G INTERIOR ELEVATION - ROOF LEVEL

Note: For Deterioration Survey Table, see page D5

△ Photo referenced in Table is of this area.



H INTERI
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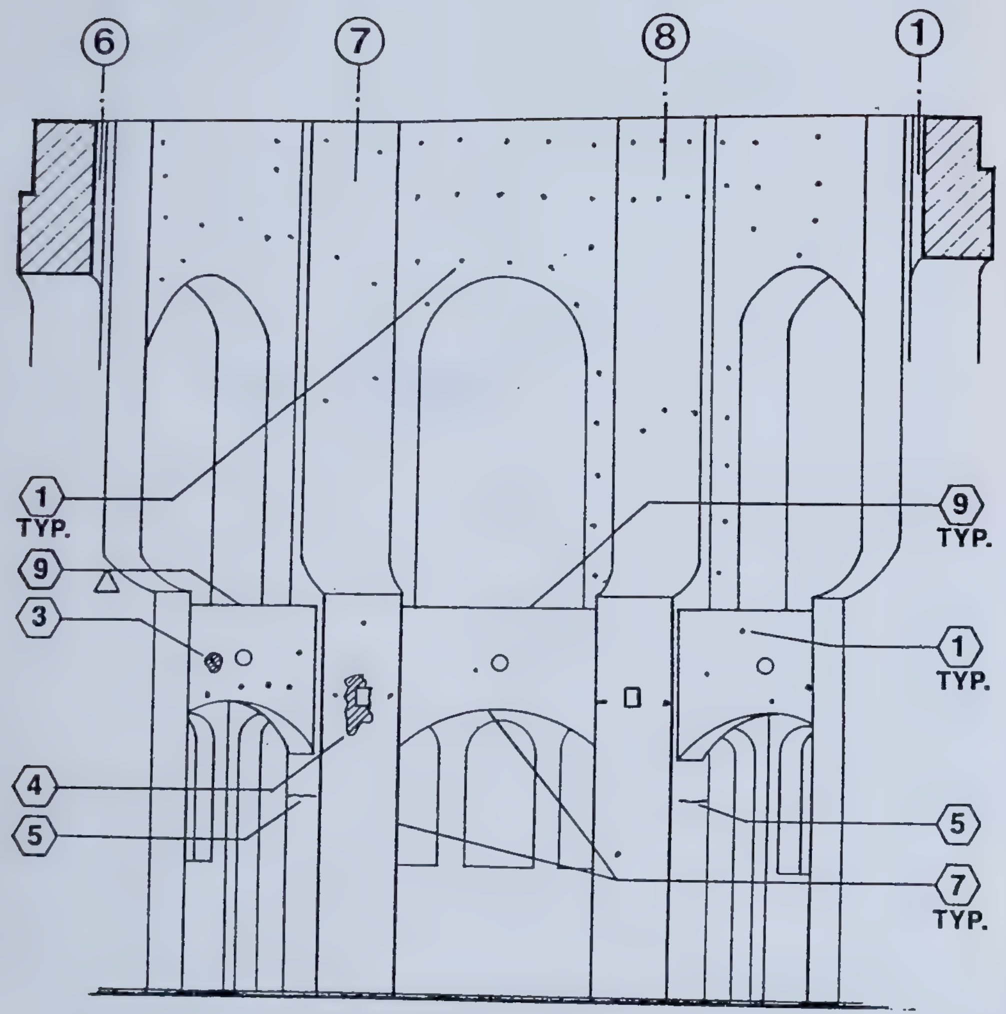
△ Photo referenced

DETERIORATION SURVEY TABLE

	Quantity	Sect.-Photo*
form tie spall, hed.	Approx. 320 ea.	F-c
" wide crack, ired.	10 Ft.	E-d
r spall, cor- nt exposed.	10 ea.	G-a
lling at exposed condult.	7 ea.	G-h
at column, 5 Ft. s than 1/32"	40 Ft.	E-e
ed reinforcement xiglass arch	4 ea.	G-a
ination of con- ting.	Entire Surface	H-b
ll	20 Ft.	E-k
rotection	Typical Cond.	K-a



H INTERIOR ELEVATION - ROOF LEVEL

△ Photo referenced in Deterioration Survey Table is of this area.

ROOF LEVEL DETERIORATION SURVEY TABLE

Item	Description	Quantity	Sect.-Photo*
1	1" to 4" diameter form tie spall, patched or unpatched.	Approx. 320 ea.	F-c
2	Greater than 1/32" wide crack, major repair required.	10 Ft.	E-d
3	4" to 12" diameter spall, corroded reinforcement exposed.	10 ea.	G-a
4	Corrosion and spalling at exposed steel electrical conduit.	7 ea.	G-h
5	Horizontal crack at column, 5 Ft. above ground; less than 1/32" wide.	40 Ft.	E-e
6	Spall with corroded reinforcement at outside of plexiglass arch coverings.	4 ea.	G-a
7	Scaling and delamination of concrete surface coating.	Entire Surface	H-b
8	Crack at stair wall	20 Ft.	E-k
9	Inadequate roof protection	Typical Cond.	K-a

* See Part III

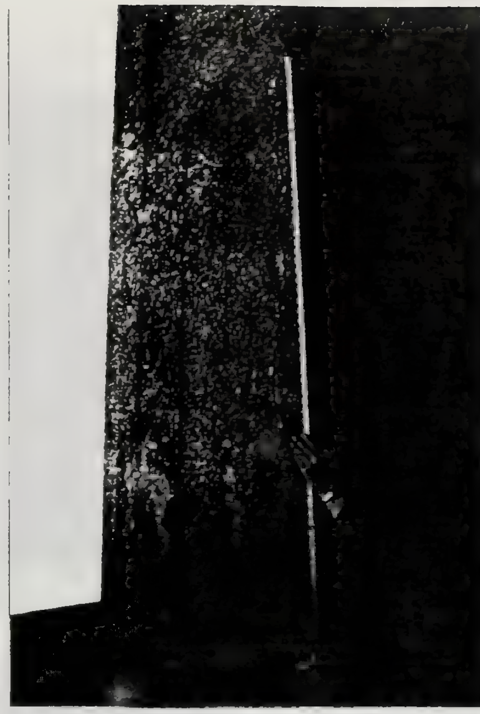
PART III

DISCUSSION OF DETERIORATION AND PROPOSED REPAIRS

E. Cracks

Discussion

Cracks of various widths and lengths are a frequent occurrence around the entire tower. They range from hairline, horizontal cracks in walls, many feet long, to 1/4 inch wide vertical cracks, 8 feet long, at column corners. Although many cracks can clearly be associated with spalling and corrosion-related delamination, there are others that are not obviously related to these sources of stress. There are a few possible causes for these cracks. The tower is exposed to the weather and some cracks may be formed during cycles of wetting and drying which cause the concrete to experience volume changes. When pressures induced by these volume changes exceed the tensile capacity of concrete, cracking occurs. A similar pressure is created by temperature differentials between the exterior surface of the concrete, warmed and cooled by the atmosphere, and the interior surface, insulated from extreme temperature changes. Additionally, some narrow cracks appear at construction joints, a common location for cracks in concrete. Wider, more severe cracks may indicate corrosion occurring in the reinforcement below.



E-a. Major Crack at Exterior Column

E-b. Minor Crack at Base Level

The locations of the cracks by size are difficult to categorize but some patterns were noted. Many of the severe cracks (3/16 inch to 1/4 inch) occur at column and beam corners. At the Belvedere level, long vertical cracks were noted in column corners. (Photos E-a) An employee of Coit Tower indicated that some cracks had opened up in a recent earthquake. Corrosive reinforcement is associated with many of these cracks. When concrete surrounding reinforcement spalls the ability of the reinforcement to act compositely with the concrete is lost, contributing to a possible hazardous condition in an earthquake.

Another repeated location of cracking was adjacent to window and grate openings. (Photo E-h). This typically is an area of high stress and some cracking is not uncommon. The final location noted for repeated cracking was at construction joints. At the base walls, horizontal cracks were noted near the ground along a line in the wall face, probably indicating a joint between the foundation and wall above. At the Belvedere level, horizontal cracks were observed along the perimeter of the wall and colonnade (Photo E-e). From the inside stairwell, a construction joint and fine crack were observed in the same location.

E-c. Minor Crack at Base Level

E-d. Major Crack at Roof Level

E-e. Minor Crack at Belvedere Level

Repair

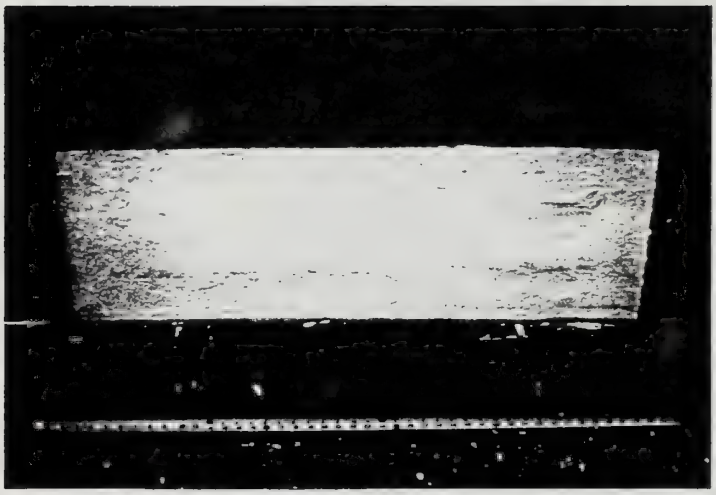
Due to the wide range of crack sizes and severity, the repair process would best be handled by a combination of procedures. A minor repair, involving injection of a sealing material is recommended for narrow cracks (less than 1/32 inch wide) or cracks located in areas of construction joints (Photo E-e) or for those due to shrinkage effects. Some of these minor cracks may remain unrepaired, depending on their size and location. A major repair, requiring that the crack be opened up, reinforcement inspected for corrosion and then patched (Photo E-g), would be required at wide cracks or where there is a possibility of corrosion occurring below. Most of the cracks on the surrounding entry walls, planters, and stairs may remain unrepaired since they appear narrow and shallow and affect non-structural concrete elements. However, prominent, deep cracks should be injected, or in severe cases, patched, to preserve the quality of the concrete. Recently patched cracks at the lower roof walls may remain without further repair.

To seal the building from abusive weather conditions and minimize damage from future cracks, it is proposed that the entire building be coated with a protective moisture barrier.

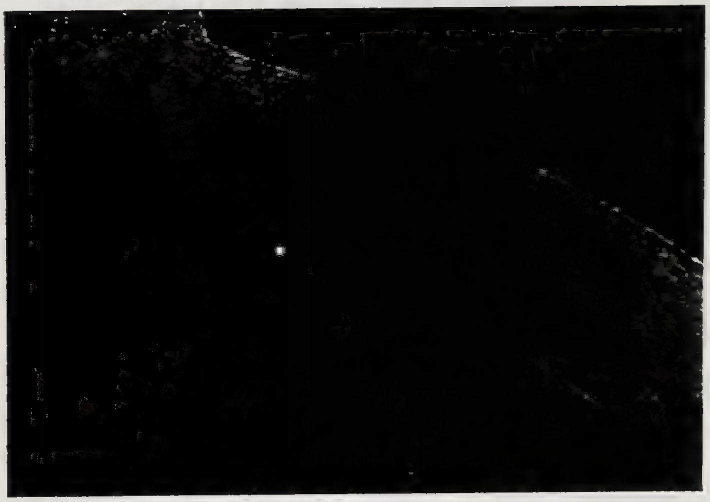
E-f. Major Crack at Belvedere Level

E-g. Major Crack at Base Level

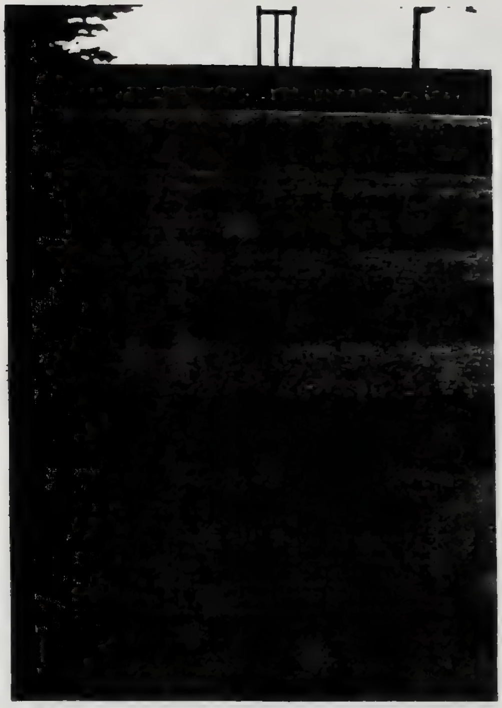
E-h. Cracking at Grate



E-j. Patched Crack at Second Floor Parapet



E-k. Crack at Roof Stairs

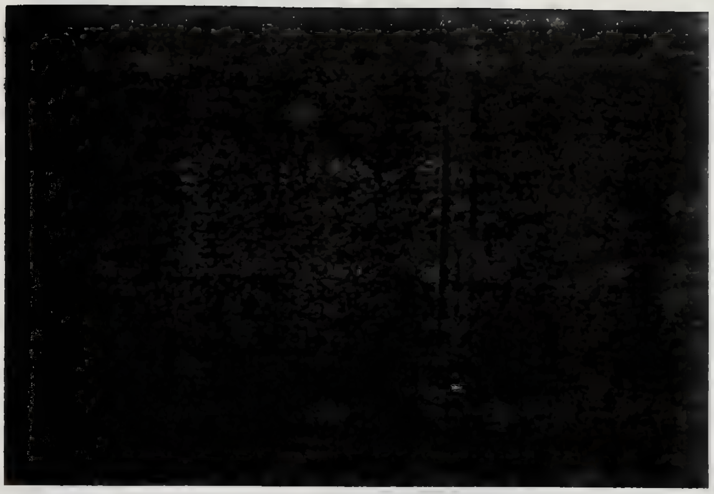


E-m. Cracking at Stairs at Entry

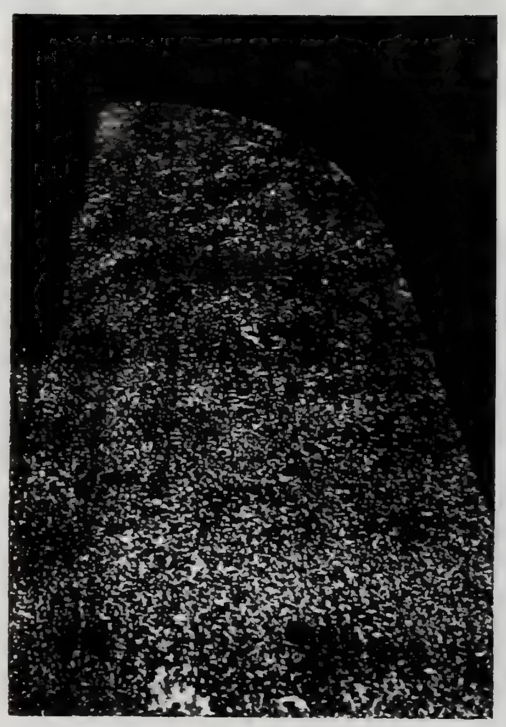
F. Small Spalls

Discussion

Small spalls are, perhaps, the most prevalent problem on the exterior of the structure. These spalls range from 1 1/2 inches in diameter to 4 inches in diameter. In the center of each spall is a small (1/8") corroded wire end (Photo F-a). This wire end is probably a form tie, left in place with insufficient concrete cover to protect it. The deterioration of the tower concrete eventually allowed the weather to penetrate the thin stucco coating and corrode the tie, creating internal pressure which spalled the surrounding concrete. Some of these small spalls have been previously patched, but most still clearly blemish the exterior of the structure. Many of the existing patches were inadequately placed and failed to arrest the corrosion, thus hiding the continuing deterioration.



F-a. Form Tie Spall



F-b. Patterned Form Tie Spalls at Belvedere Level

There is often a definite pattern to the location of these spalls, as can be noted on the elevations presented in this report (Photo F-b). The pattern of the spalls observed at the Belvedere and Root levels, supports the theory that they are form ties. However, at the Base level there is a certain randomness to their location. This may be because some ties have not yet been affected. The tie ends

may either have greater concrete cover or corrosion is occurring at a slower rate. The number of spalls, including previously patched spalls, is estimated to be over 6,000.

Repairs

Though the pitting of the walls is unsightly, it is generally not a structural problem and probably will not propogate into a more severe condition. If the corroded tie is close to a larger bar, however, corrosion may be initiated in that bar, too. Therefore, to enhance the overall condition of the building, and prevent further deterioration, each small spall should be repaired.

It is recommended that the loose, disintegrated concrete surrounding the corroded form tie or reinforcement be hammered out, exposing all the corroded steel. The steel should then be cut off, at least half an inch beyond the corrosion. The edge of the concrete area should be cut to prevent feathering and to provide a keyed patch. Existing patches should be removed and replaced in a similar way. Slight bumps and flaky cracks in the surface should be tapped with a hammer to determine if a corrosion or delamination has begun below the surface. If the concrete flakes off, the area should be patched as a typical small spall. A less rigorous repair would be

F-c. Form Tie Spalls at Roof Level

F-d. Form Tie Spall on Retaining Wall

G. Large Spalls

Discussion

G-a. Spalls with Exposed Reinforcement

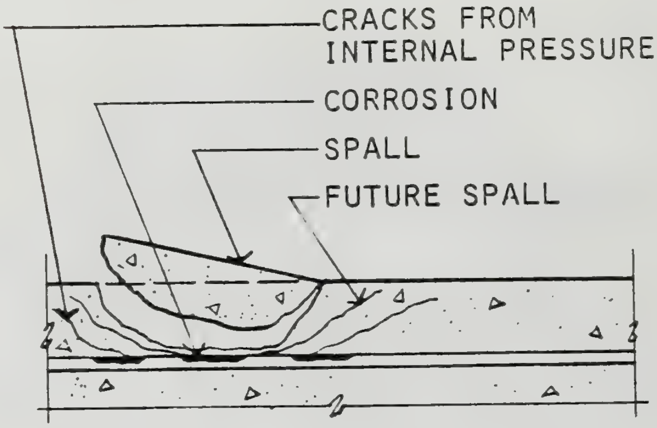
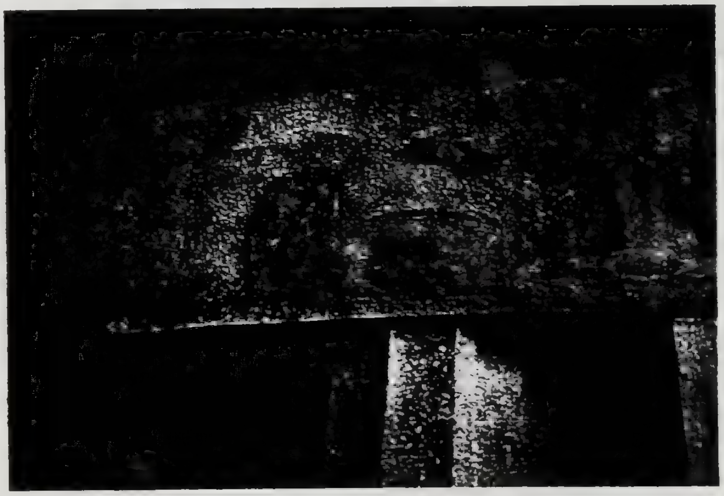


Fig. G-1. Spall



G-b. Patched Spalls over Columns

Large spalls, due to stress generated from the corrosion of reinforcing steel (Figure G-1), occur at random locations around the structures. These spalls and associated cracks are mainly caused by weathering and lack of adequate concrete cover between the reinforcement and the exposed surface. The ability of concrete to protect the steel from corrosion is diminished by exposure to extreme weather conditions. Although Coit Tower may be exposed to corrosive sea air, chemically analyzed concrete samples were found to be free from excessive amounts of contaminants such as chloride and sulfate. However, moisture may still penetrate the chemically sound concrete, thus initiating the deterioration process of cracking, steel corrosion and spalling. Although some spalls have been previously patched, the corrosion potential is still high, depending upon the effectiveness of the patch.

There appears to be no pattern to these large spalls. However, some general observations can be made. More severe spalling appears on the face of the beam over the columns (Photo G-b). A majority of these spalls have been patched, but rust and white carbonation deposits on the soffit below provide evidence that

corrosion is still occurring (Photo G-c). These deposits, found in other locations as well, may be an indication of corrosion of reinforcement and a weakening of the chemical bond of concrete. A specific type of spall caused by crevice corrosion was evident at the roof level around or near abandoned electrical fixtures. This corrosion is due to the localized chemical reactions due to material differences of the concrete and the exposed steel.

G-c. Delamination at Beam Soffit

Repair

The repair procedure for spalls needs to be adjustable and adaptable depending on the scope of the corrosion occurring. Each spall will require some type of patch, and existing patches should be removed and replaced. Figure G-2 shows recommended patch preparation. A good concrete patch requires the removal of all loose, disintegrated concrete including concrete that shows evidence of active or potential spalling. Since delaminated areas or spalls may extend beyond the area of the exposed bar, concrete in the surrounding areas should also be removed. If more than 1/2 of the circumference of the bar is exposed before or during the removal process, the bar should be completely exposed with sufficient clearance under the bar to insure encasement and bond with the new

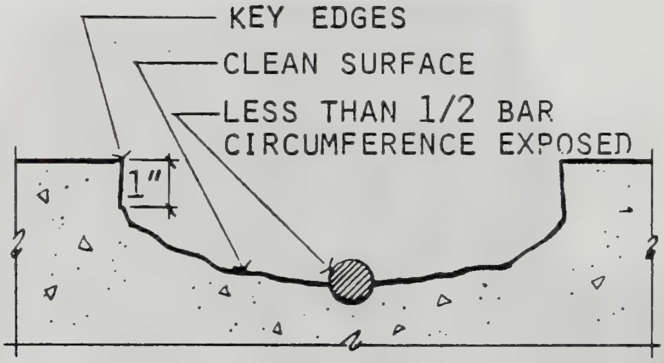


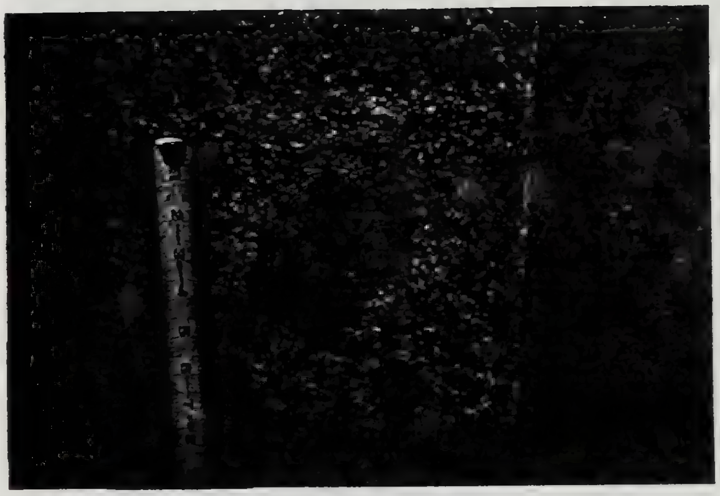
Fig. G-2 Preparation of Spall for Patch

G-d. Spalling at Water Spigot

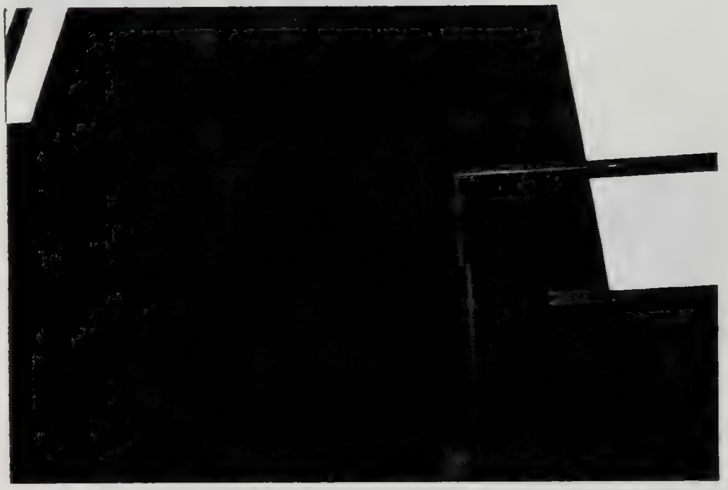
patch. All steel should be cleaned, and loose, scaly rust must be removed. Areas to receive a concrete patch should be cut to prevent feathering and to provide a keyed patch. Reinforcing bars located in areas too near the surface to receive a concrete patch should be removed or painted. Some spalled areas, such as column corners and beam soffits will require special concrete forms to complete the repair properly. The patching concrete material may be modified with latex or polymer to improve its bonding and water resistence and to give it properties similar to the original concrete.

It is recommended that the spalls caused by crevice corrosion at the non-operational electric fixtures be repaired by a similar process. This would involve entirely removing the corroded light fixture and filling the hole with patch material. If desired, an alternate repair procedure could be developed to install new light fixtures and patch the surrounding spalls.

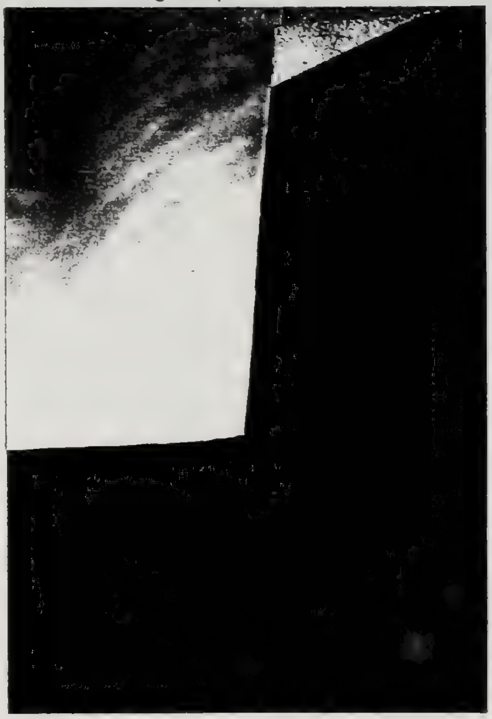
Finally, to insure that future deterioration of concrete is held in check, a protective coating should be placed on all surfaces. This coating is discussed in Section H.



G-e. Patched Spall

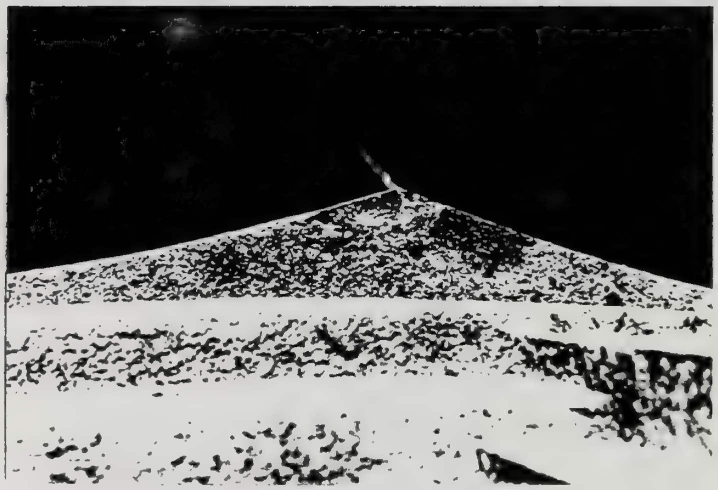


G-f. Large Spall at Entry



G-g. Large Patched Spall

G-h. Spall at Light Fixture



G-j. Deterioration of Fluted Corner

H. Surface Coating Delamination

Discussion

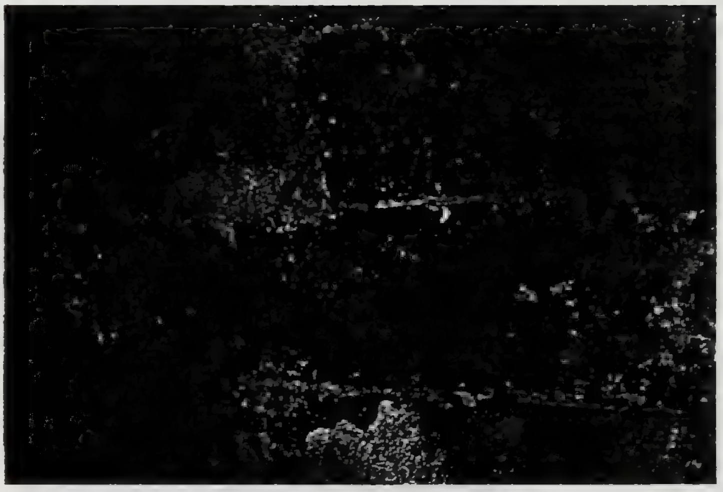
A prevalent condition on exposed concrete surfaces is chipping and peeling of the existing concrete surface coating. The coating appears to be a stucco or sand based cement plaster, applied very thinly over a majority of the tower surfaces. In some areas the coating has been painted and in others, left unpainted. The major cause of the deterioration of the coating is the harsh environment surrounding the tower. The damp and cold atmosphere has penetrated the coating and may have caused the concrete beneath to suffer carbonic acid attack as evidenced by the white deposits on the surface.

The ineffectiveness of this coating to protect the concrete from moisture penetration results in greater deterioration of the exposed structural concrete.

Repair

To preserve, as much as possible, the integrity of the structural concrete, the existing coating should be removed and replaced with a more effective, durable type of coating. Before any repairs are made, the existing coating should be removed by steel brush, sandblasting, or

H-a. Surface Coating Delamination



H-b. Ceiling Scaling at Roof Level

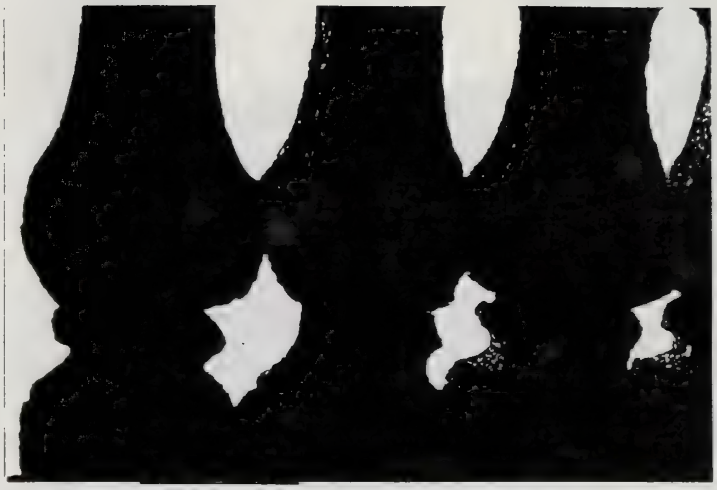
J. Balustrade Deterioration

Discussion

The scaling and crumbling of the concrete balustrade at the Belvedere level is a unique problem. The balustrade encircles the Belvedere level and is a prominent architectural feature. Once again, however, severe weather conditions have caused damage ranging from minor scaling and cracking, to disintegration and separation of concrete due to corrosion. In some places, the concrete easily breaks off, creating a hazardous situation to people and property below.

Repair

It appears, from the drawings and field inspection, that the balusters are precast items attached to the cast-in-place handrail with dowels. The repair may be accomplished by replacing all attached balusters and rail with a new, identically precast unit. This unit could consist of individual balusters, assembled in place with a cast handrail, or a complete unit, assembled on the ground and lifted into place. This unit would then be protected with the same coating as the rest of the structure.



J-a. Overall View of Balustrade

J-b. Spall at Baluster

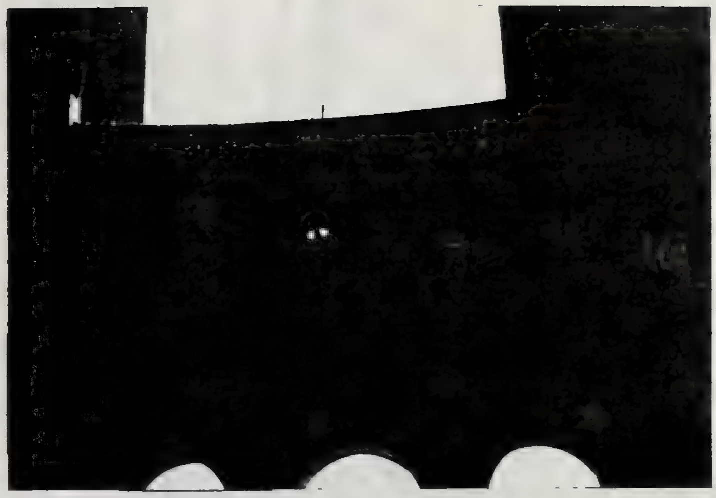
K. Upper Roof Deterioration

Discussion

Above each archway on the Roof level, there is a depressed roof area, approximately four feet by seven feet. The ceiling beneath this area is peeling and flaking indicating that water may be penetrating the roof slab. Fine cracks were observed on the bottom surface of the roof slab. In addition, the previous roofing material is almost entirely disintegrated. At the inside parapet of each roof area, a scupper was provided to drain the roof water from the roof to the deck below. However, the delamination of the ceiling below indicates that these scuppers are not functioning adequately. To prevent scaling of the new surface coating, this area should be provided with new roofing and a positive drain.

Repair

It is recommended that a sloping topping of concrete be applied, if necessary, to ensure that water will drain from the roof to the scupper. A waterproof membrane should be applied over this topping to protect the concrete.



K-a. Scupper at Upper Roof

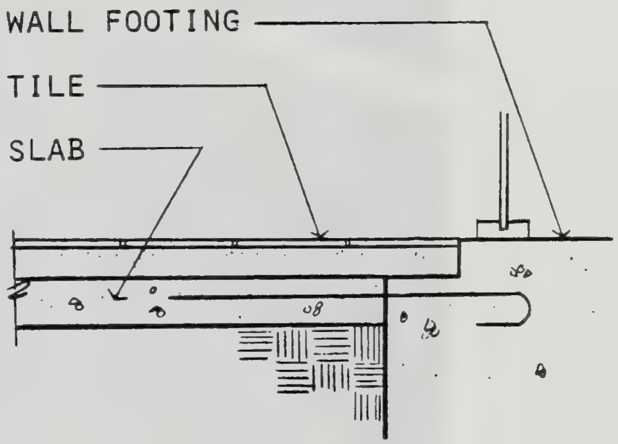
K-b. Upper Roof Slab Crack

L. Lobby Tile Crack

Discussion

At the West wall of the lobby, there is a wide crack along the edge of the tile floor near the windows (Photo L-a). A detail of the connection of the floor slab to the perimeter footing at this location was found in the original structural drawings, Section D-D, Sheet 53A. Figure L-1 is a reproduction of the slab joint detail. Either settlement of the soil or rotation of the footing may have caused a void to form under the slab. The slab settling into this void created stresses which cracked it and the floor tile.

L-a. Lobby Floor Crack



L-1. Tile and Slab Connection

Repair

It may be necessary to investigate the soil below the slab to determine if additional settlement may occur. This study would involve removing the tile and base material adjacent to the crack, coring the slab and performing a soil consolidation test in place. The soil could then be stabilized and compacted as required. The slab could then be replaced or repaired as required. The tile base material would be replaced and built up, and the original, or matching tiles placed. A less rigorous repair would be to simply replace the tile, assuming that the slab will not settle

M. Soil-Related Damage

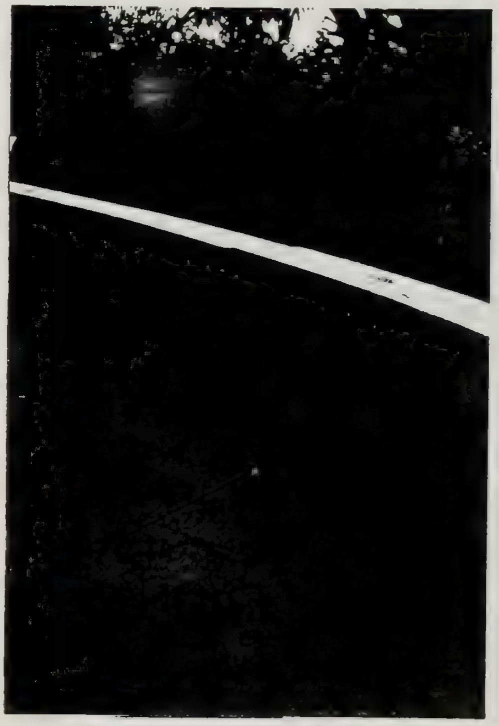
Discussion

The walkways, planters and retaining walls immediately surrounding the Coit Tower Monument exhibit damage that can generally be associated with soil contact. One example of soil-related damage occurs at large box planters with narrow horizontal cracks visible on the exterior a few feet from the top. Often water was observed leaking from these cracks or nearby spalls. Apparently water collects in these planters and, rather than draining through the 2 feet of soil to the 1 inch weep hole provided in the bottom of the planter, runs out these side cracks creating spalls and stains.

Another soils problem occurs at the lower east retaining wall near the entry stairs. The stump of a large tree is hidden behind the wall, indicating a powerful root system once pushed the retaining wall and caused the severe cracking and rotation evident in Photo M-a.

On the west side of the tower the concrete walkway is badly cracked and uneven, reflecting settlement of the fill below. The adjacent retaining wall has displaced 1 inch. No weep holes were observed in the retaining wall,

M-a. Front Retaining Wall

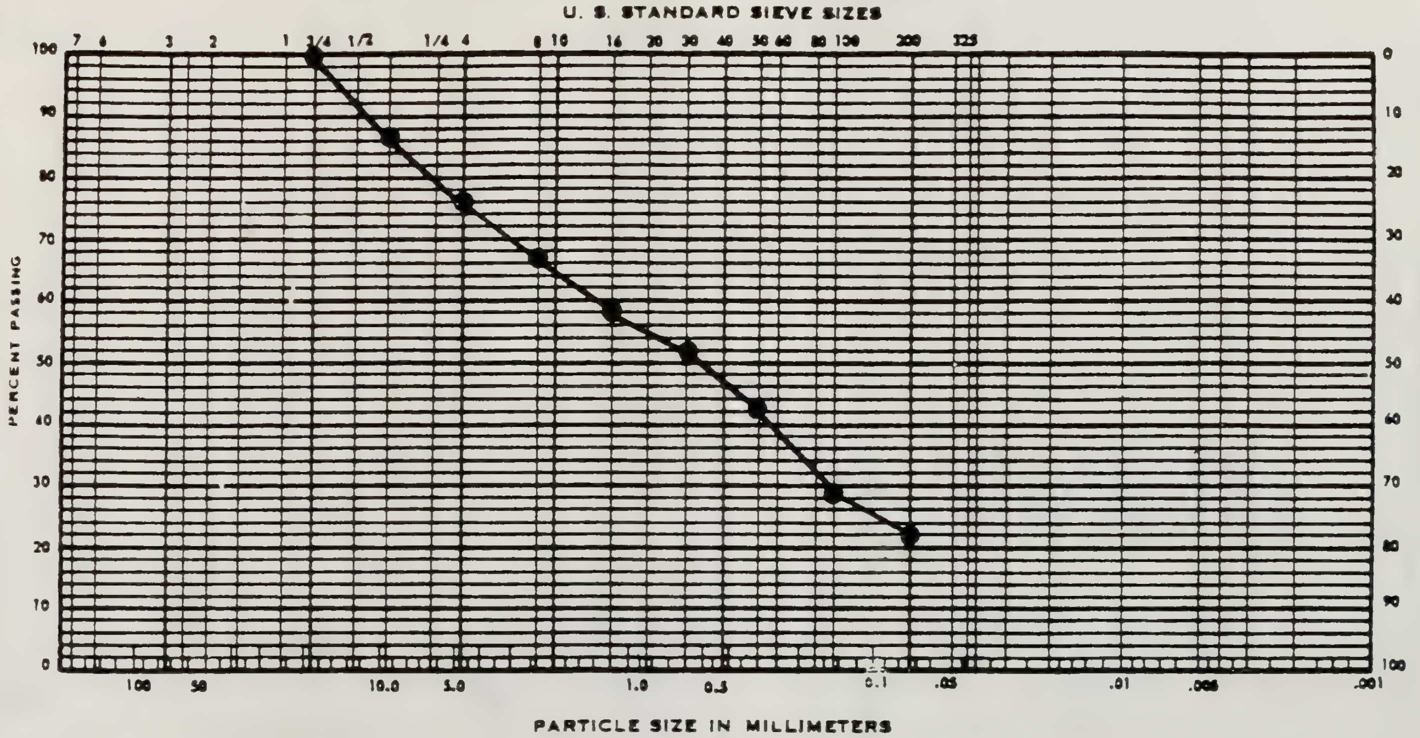


M-b. West Walkway and Retaining Wall

Exhibit CC

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
●	2	1½	-	SC	Brown Gravelly Clayey Sand

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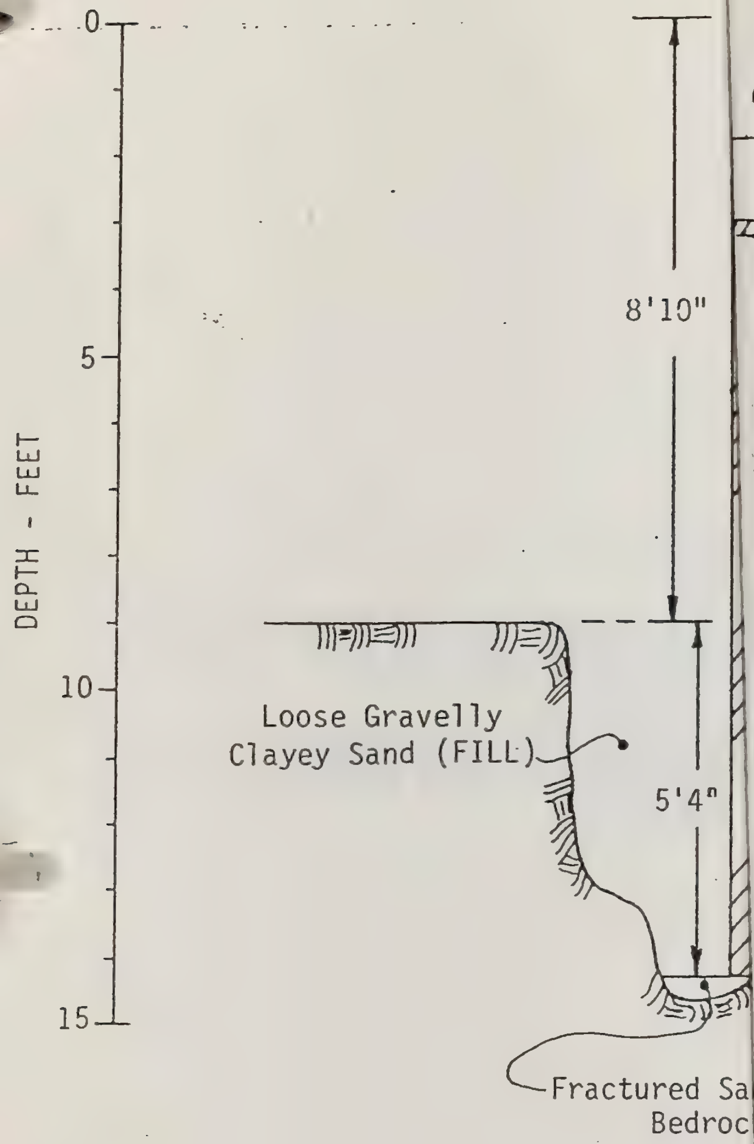
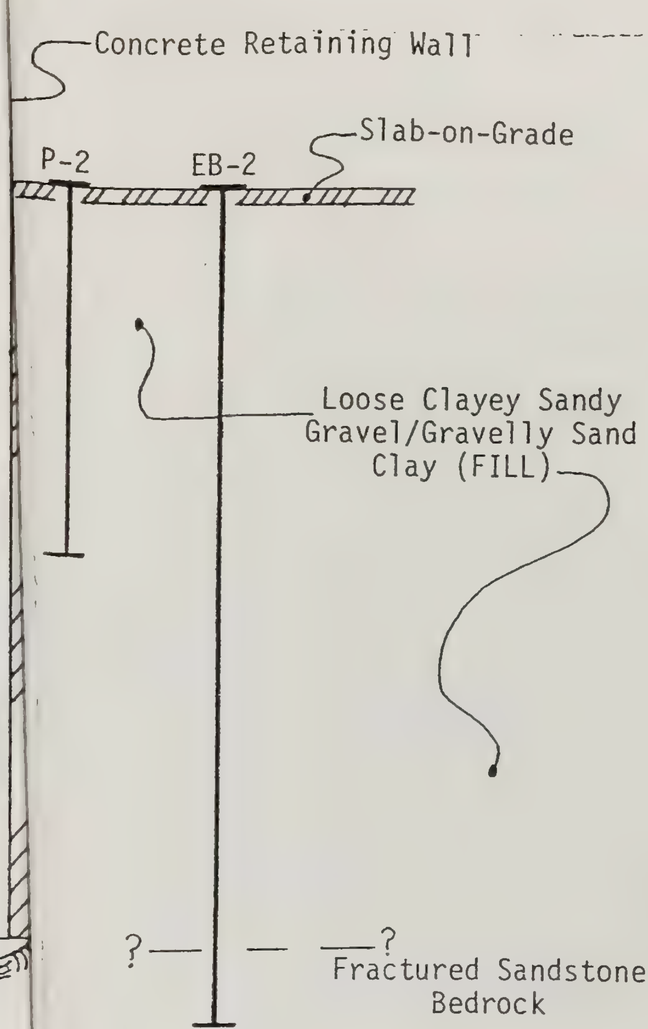
Geotechnical Consultants

GRADATION TEST DATA		
Exterior Slabs/Walls at Coit Tower San Francisco, California		
PROJECT NO.	DATE	Figure A-3
1547-2	May 1985	

TEST PIT 2 -



TEST PIT 1 - FACING NORTH



Sandstone Bedrock

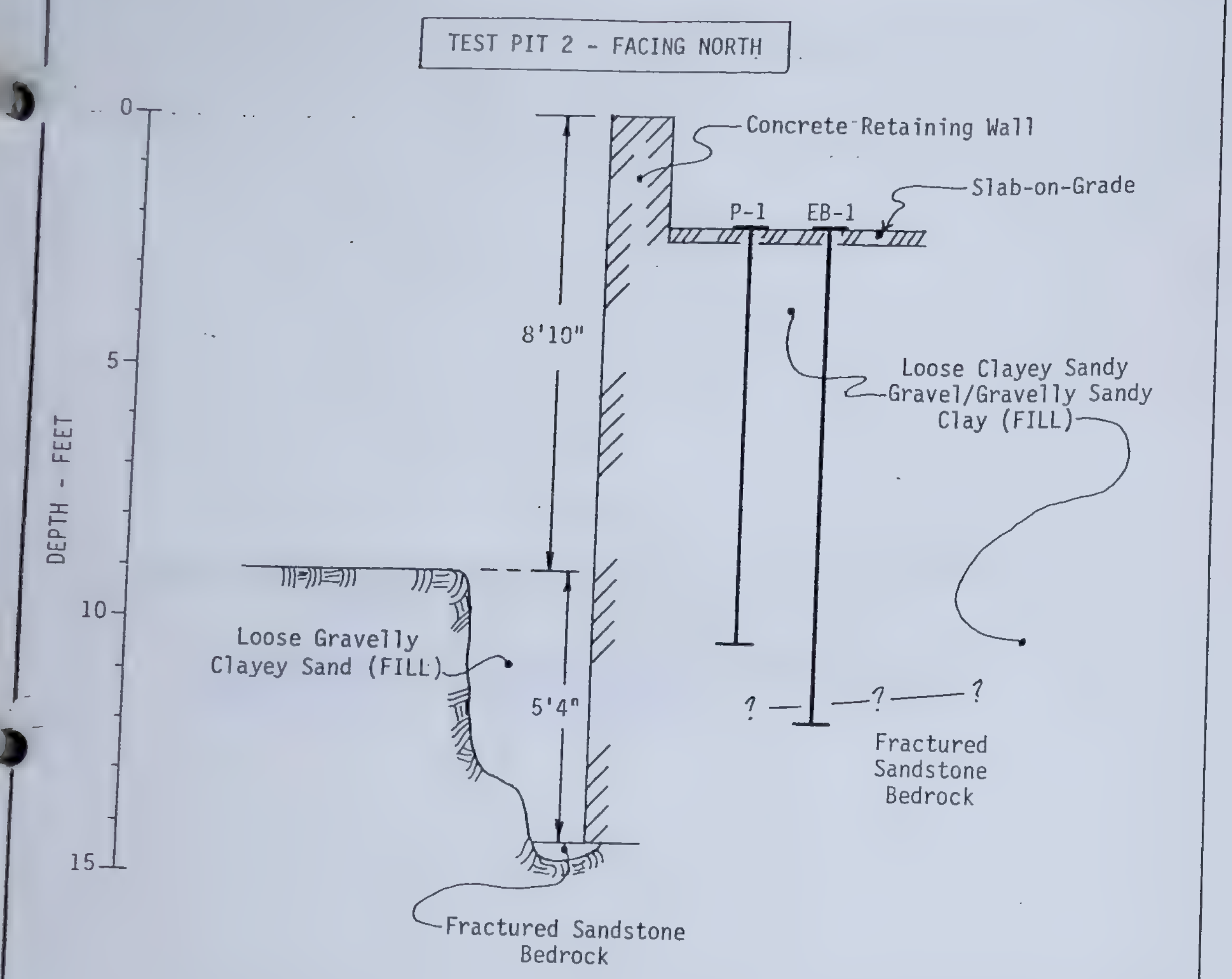
NOTES:

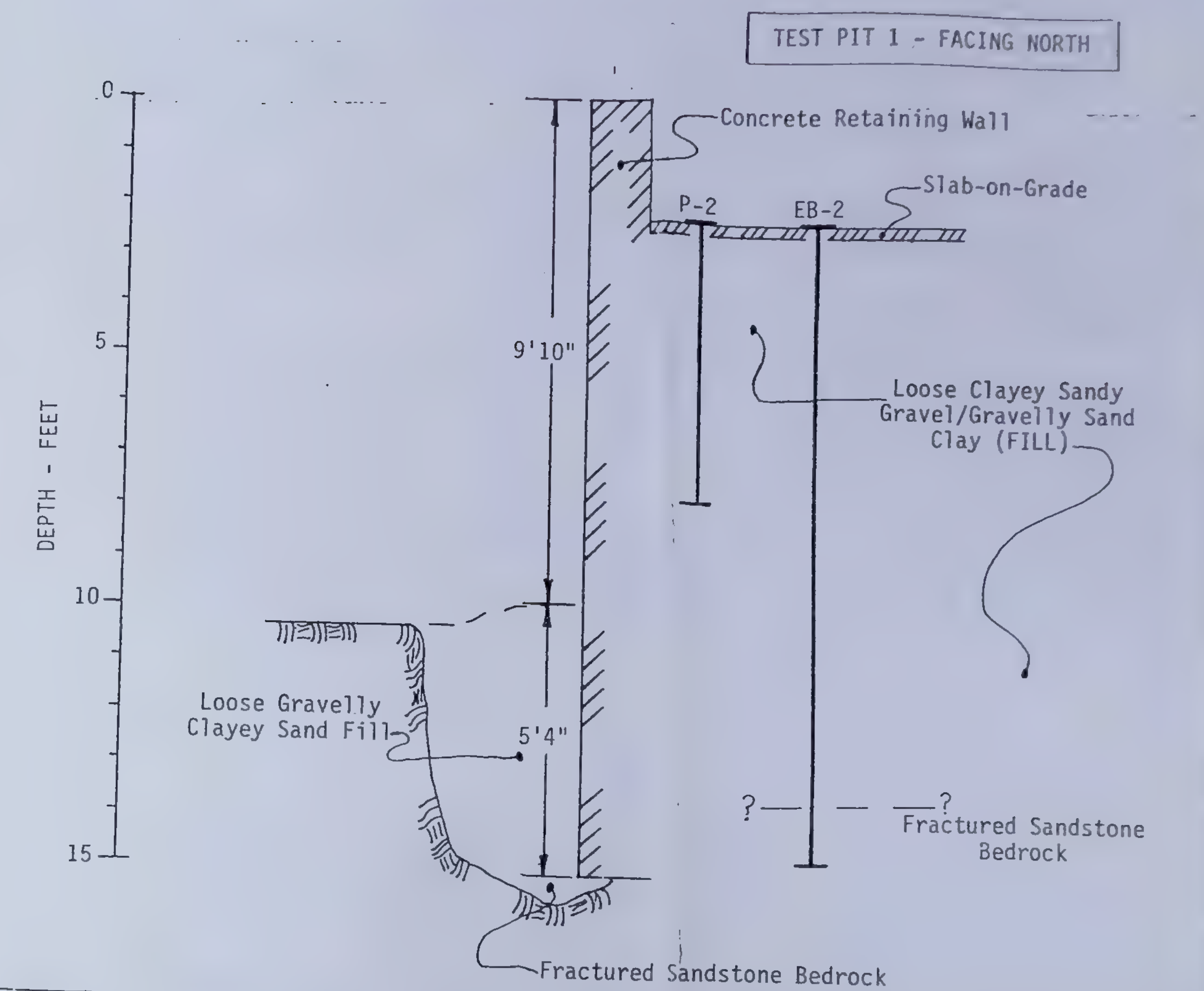
(1) Test pits were excavated on 3-25 a

(2) See Figure 1 for locations of test

(3) Stratification lines represent app
actual transitions are gradual.

LOGS OF EXPLORATORY TEST PITS		
Exterior Slabs/Walls at Coit Tower San Francisco, California		
CT NO.	DATE	FIGURE: A-2
-2	May 1985	





NOTES:

(1) Test pits were excavated on 3-25 and 3-26-85.

(2) See Figure 1 for locations of test pits.

(3) Stratification lines represent approximate boundaries between material types; actual transitions are gradual.

Don Hillebrandt Associates
Geotechnical Consultants

LOGS OF EXPLORATORY TEST PITS

Exterior Slabs/Walls at Coit Tower
San Francisco, California

PROJECT NO.	DATE	FIGURE: A-2
1547-2	May 1985	

EXHIBIT CC.

REPORT ON COIT MEMORIAL TOWER, SAN FRANCISCO, CALIFORNIA,
ROOF SURVEY & SUMMARY OF OBSERVATIONS

PREPARED BY: TECHNICAL ROOF SERVICES, INC.
PREPARED FOR: THE CITY AND COUNTY OF SAN FRANCISCO
APRIL 26, 1985

COIT MEMORIAL TOWER

SAN FRANCISCO, CALIFORNIA

ROOF SURVEY

&

SUMMARY OF OBSERVATIONS

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

COIT MEMORIAL TOWER

SUMMARY OF OBSERVATIONS

A. Base Level

The existing roof system is comprised of a three-ply asphalt and gravel built-up roof over a paver tile split slab construction. The highest concentration of moisture just beneath the membrane was around the perimeter of the tower walls and the parapet walls.

There is evidence of previous repairs from the counter-flashings to the concrete plaster surfacing as well as to various wall penetrations. These repairs consist of caulking, elastomeric coatings and elastomeric coatings on the roof area.

At one particular "bulged" area of the concrete plaster on the west parapet wall, moisture was verified in the elastomeric coating (Photo A) beneath the surface skin of the coating, indicating moisture penetration of the concrete plaster surfacing. For purposes of comparison, another sample of the elastomeric coating was checked for moisture content by electrical continuity (Photo B) and no continuity was observed, indicating a dry sample.

Additional areas were observed two days after a severe rain and continuity tested for moisture. Our findings were observed by taking comparative electrical continuity readings above the counterflashings (Photo C) and then beneath the counterflashings behind the base flashing (Photo D) of the roof system. In all cases, continuity readings were observed at both test locations, indicating water migration into the concrete plaster surfaces, behind the counterflashing system and behind the base flashing of the roof system.

This moisture migration behind the roof system into the split slab construction will aid in causing premature failure of the existing roof membrane through potential blistering and decomposition.

REPORT

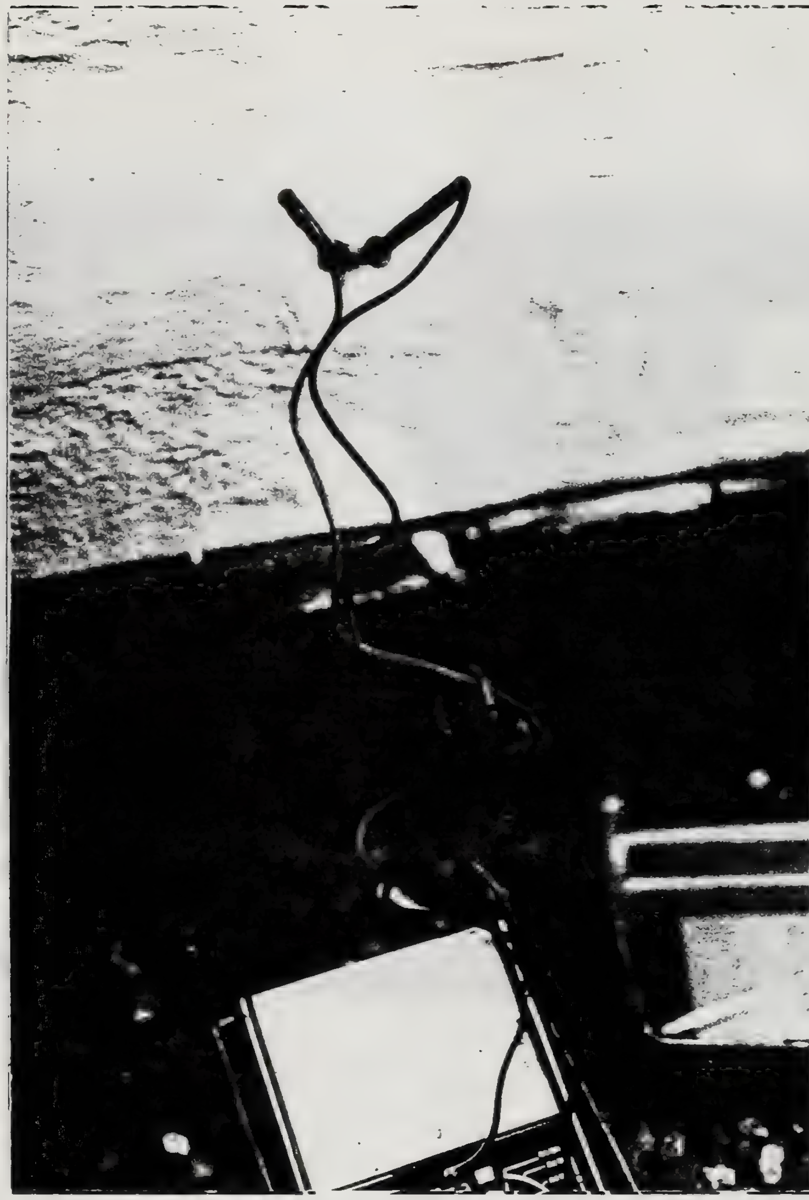


PHOTO A

REPORT

PHOTO B

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

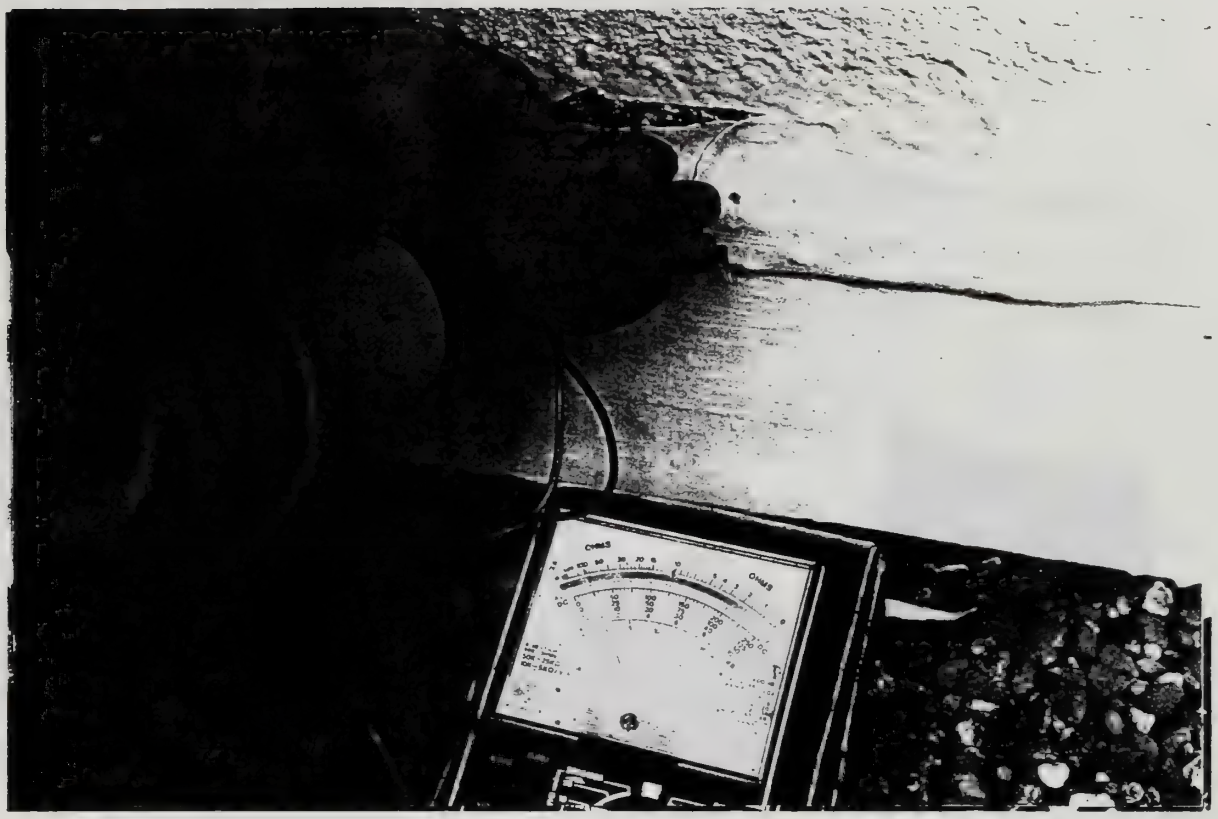


PHOTO C

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

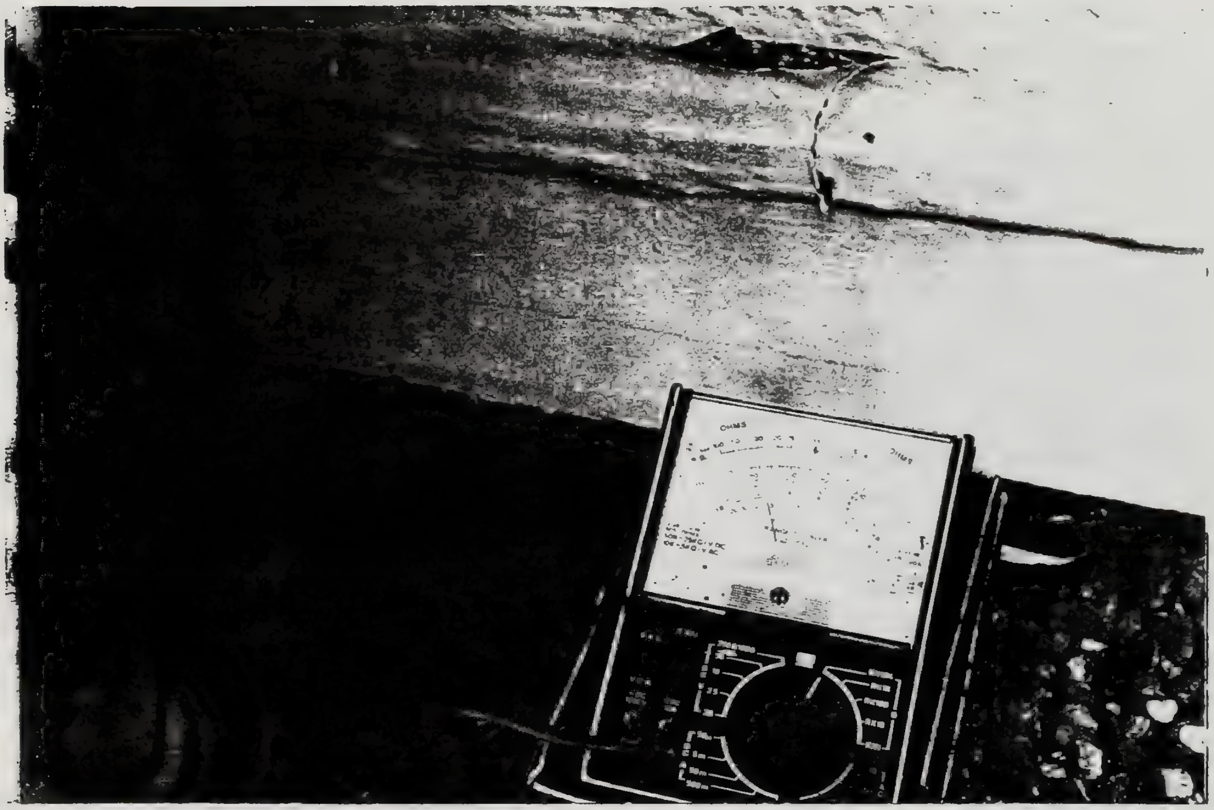


PHOTO D

REPORT

Twenty-two leaks were observed (Photo E) in the first floor ceiling and walls, mainly on the west and south corridors. The leaks appear on the ceiling and walls as efflorescence and leak stains. The stains are occurring at cracks in the structural slab. It is unknown what the exact cause of the stains is (i.e., asphalt oils, rust).

There are missing counterflashings on one of the triangular section walls which also could contribute to leakage.

Test cuts of the base flashing on the main roof area did not indicate any significant leak causes; however, no cant strip was used in the base flashing assembly and voids exist where the membrane attempts to bridge the 90 degree angle. We also observed uneven moppings at the horizontal to vertical intersections, potentially creating a weak point in the roof system (Photo F). No extra reinforcing plies are present at the base flashings.

No interior leakage was observed from a 48-hour watertest on one section of the west portion of the roof deck itself. Membrane application over a split slab construction is not desirable due to potential blistering and moisture migration; however, it does not appear that the roof membrane itself is a contributing factor to leakage in the area tested.

The following photographs show varying amounts of continuity, indicating moisture presence.

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Client: City of San Francisco

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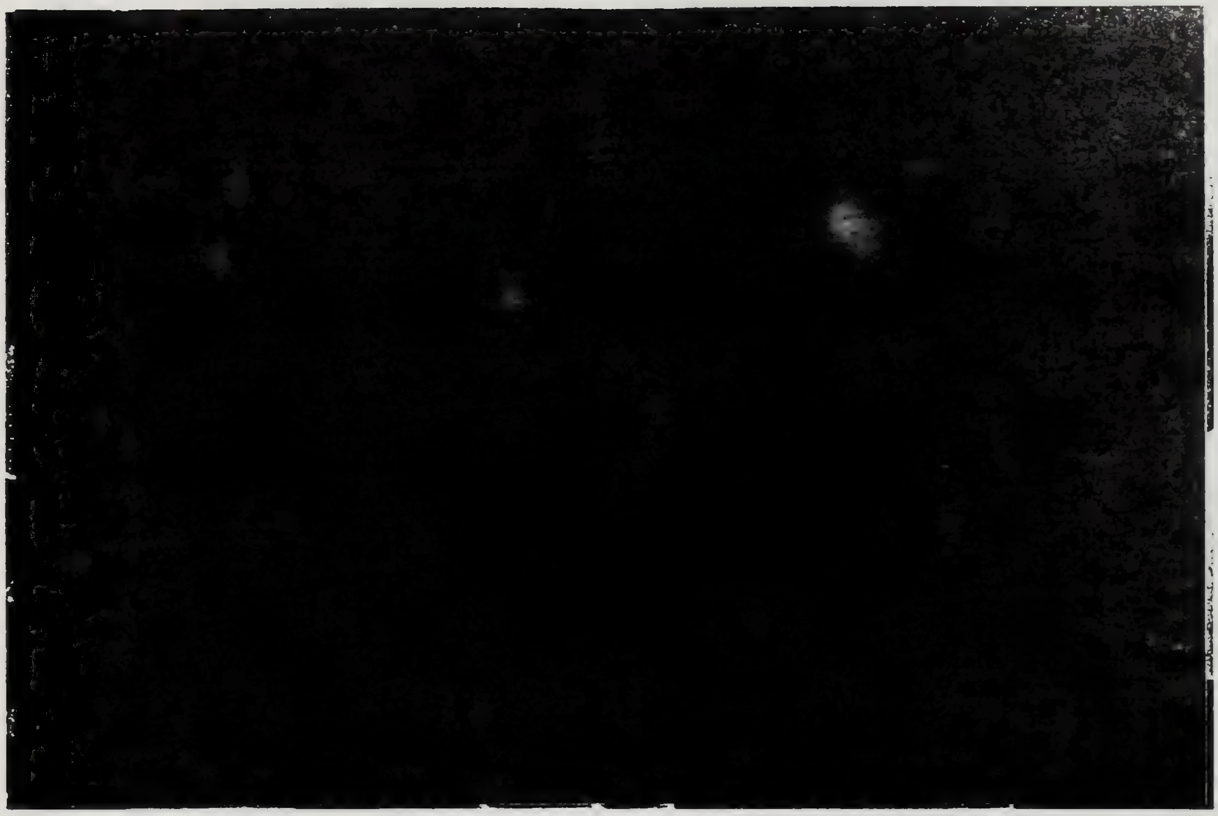

PHOTO E - 1

REPORT

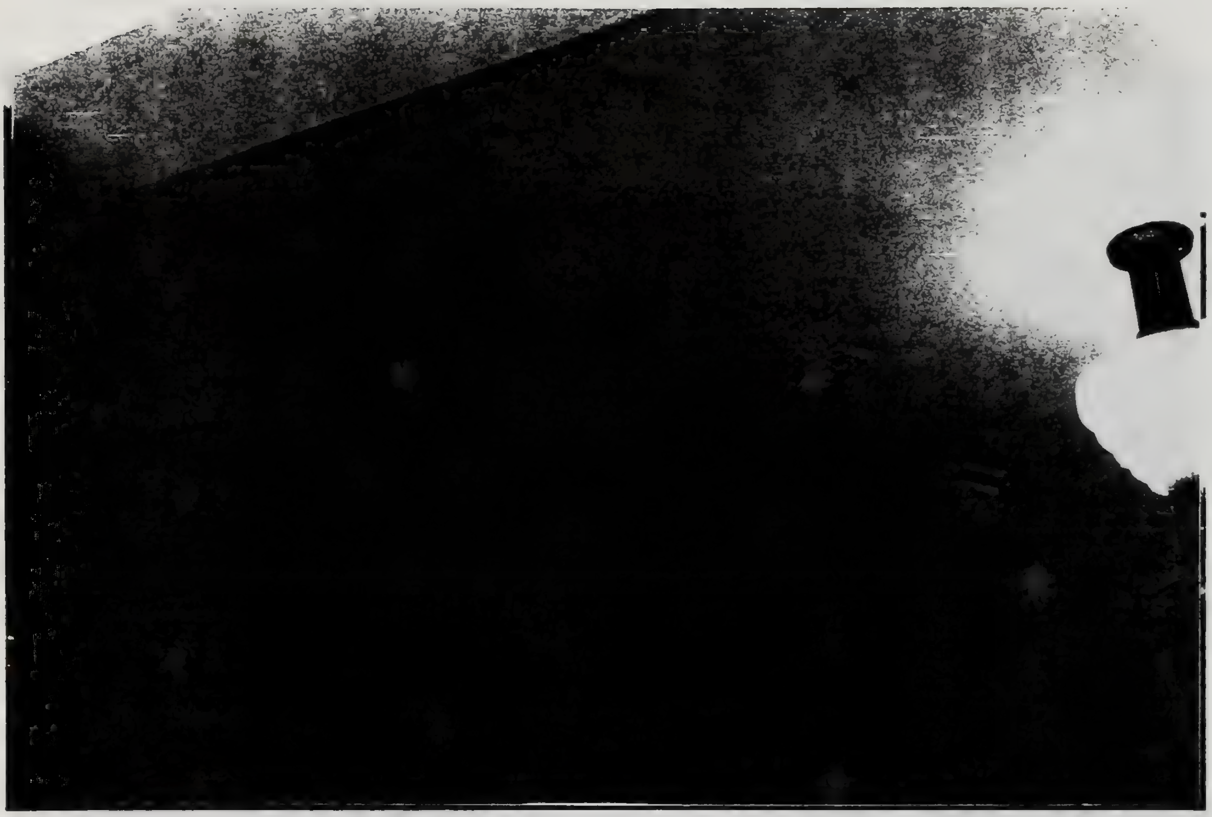

PHOTO E - 2

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

PHOTO F

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

PHOTO G
Moisture indicated behind caulking
in construction joint.

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File No. 85032

Client: City of San Francisco

REPORT

PHOTO H
Same area as Photo G but behind roof flashing.

REPORT

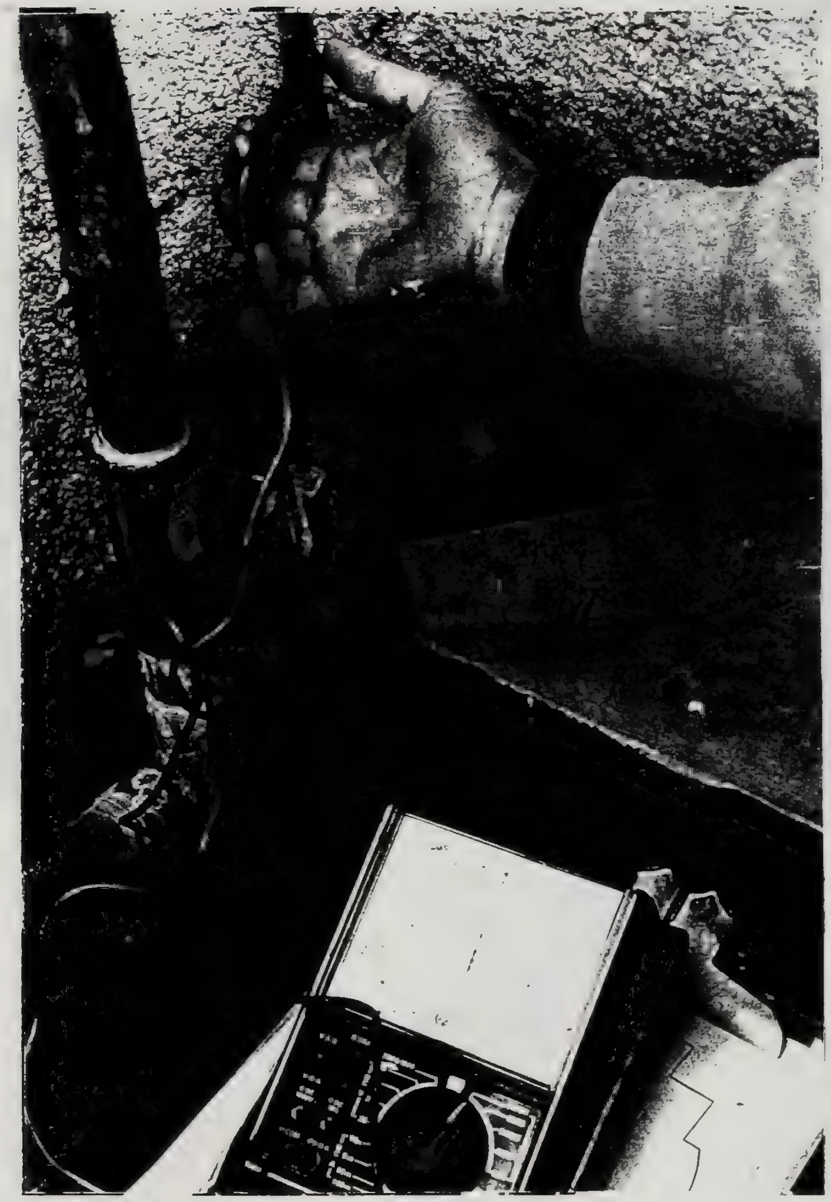

PHOTO I
Moisture indicated behind a different construction joint.

PHOTO J
Crack in plaster surfacing above
area of Photo I.

REPORT

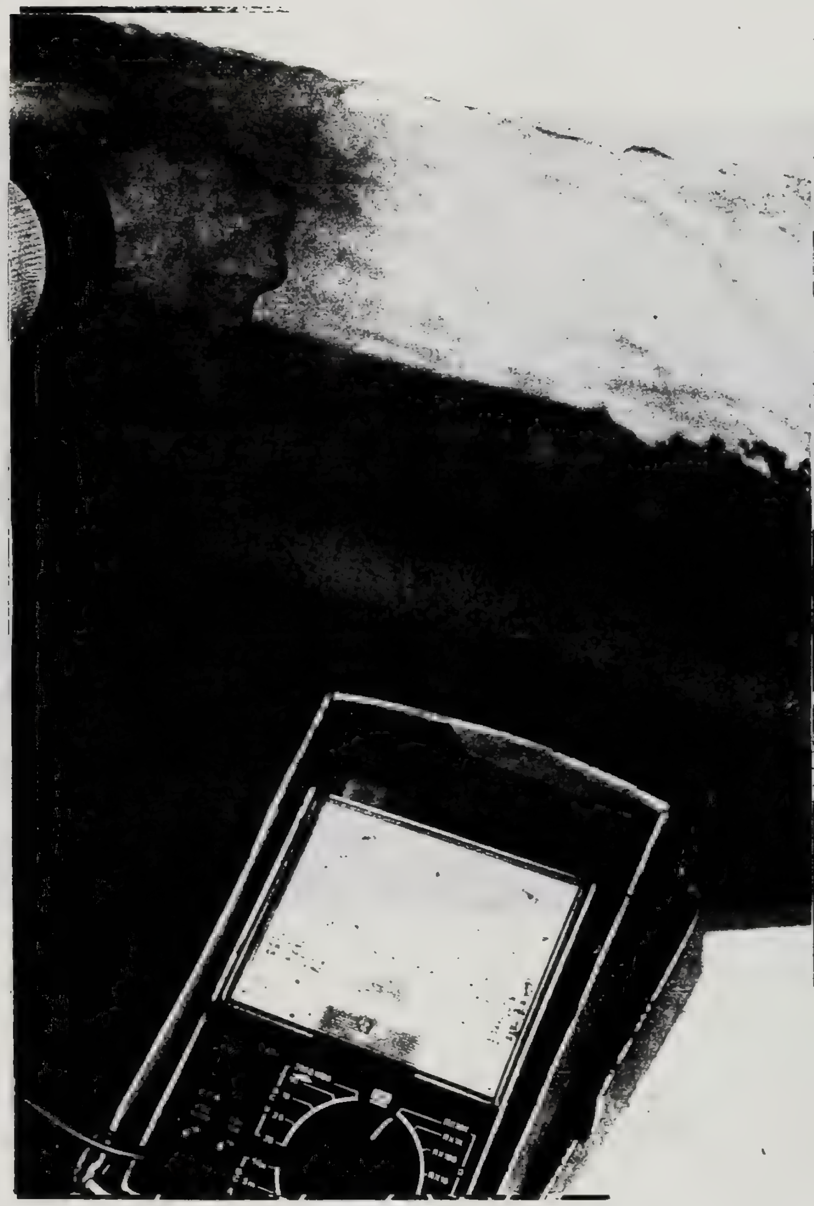

PHOTO K
Moisture indicated in plaster behind elastomeric wall coating.

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

Photo L - 1

Observe previous trapped water level.

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

PHOTO L - 2
Caulking of bottom was cut after 1 hour water test and water released under pressure.

PHOTO L - 3

Typical caulking failure and open areas.

REPORT

B. Balustrade Level

This area also appears to be of a split slab construction with a reinforced elastomeric membrane over the topping slab. The base flashing system of the overlaid membrane terminates on the exterior face of the concrete plaster surfacing (Photo M).

There is cracking of the membrane at various base flashing locations with indication of moisture behind the membrane system (Photo N). The top edge termination of the base (Photo P) flashing is showing adhesive release in a few isolated locations. A continuity test of one of these areas two days after a rain gave a positive low reading, indicating moisture penetration behind the membrane system.

The spotlights are in recessed metal sumps with removable opaque glass covers (Photo Q). The metal itself is rusted and the oxidized metal is flaking off. The metal sumps also serve as the drains for this roof area. It appears the water leaking from this area would not present an aesthetic problem, but over a period of time, could contribute to structural deterioration.

Date: April 26, 1985

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Client: City of San Francisco

REPORT

PHOTO M

REPORT

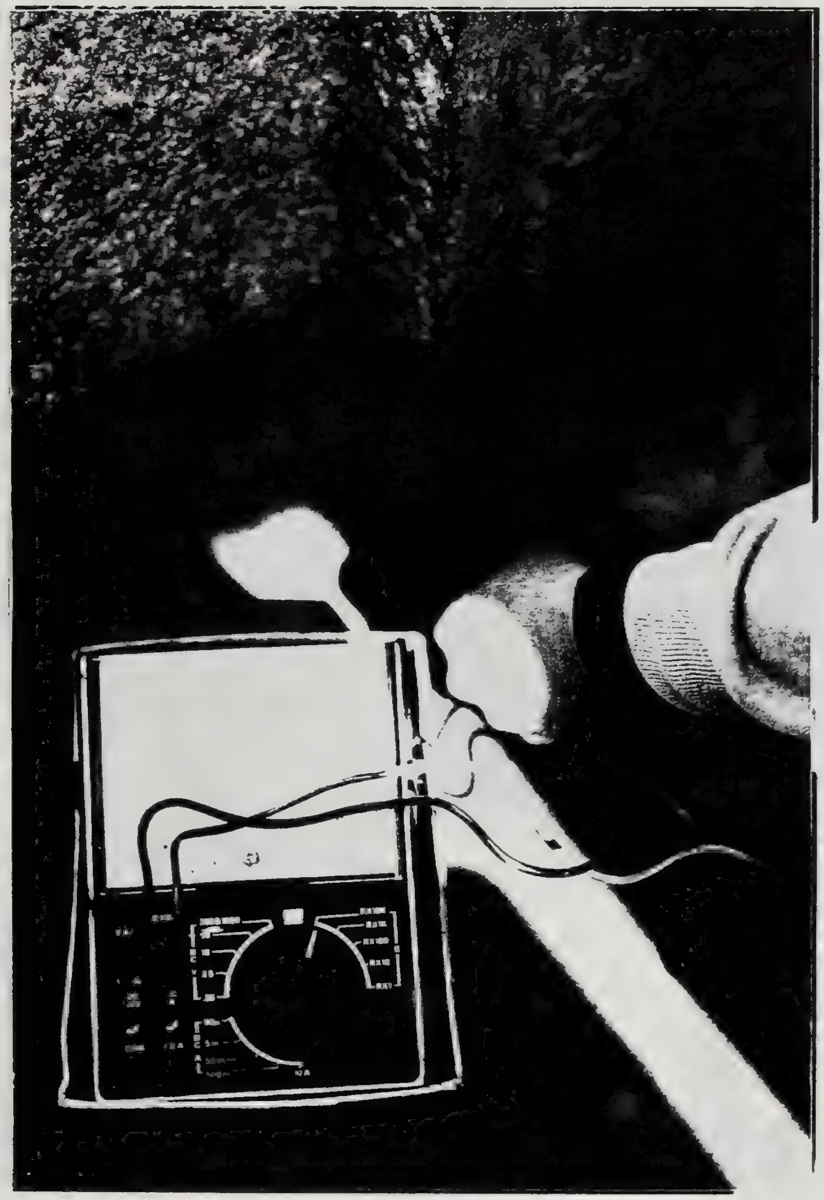


PHOTO N

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

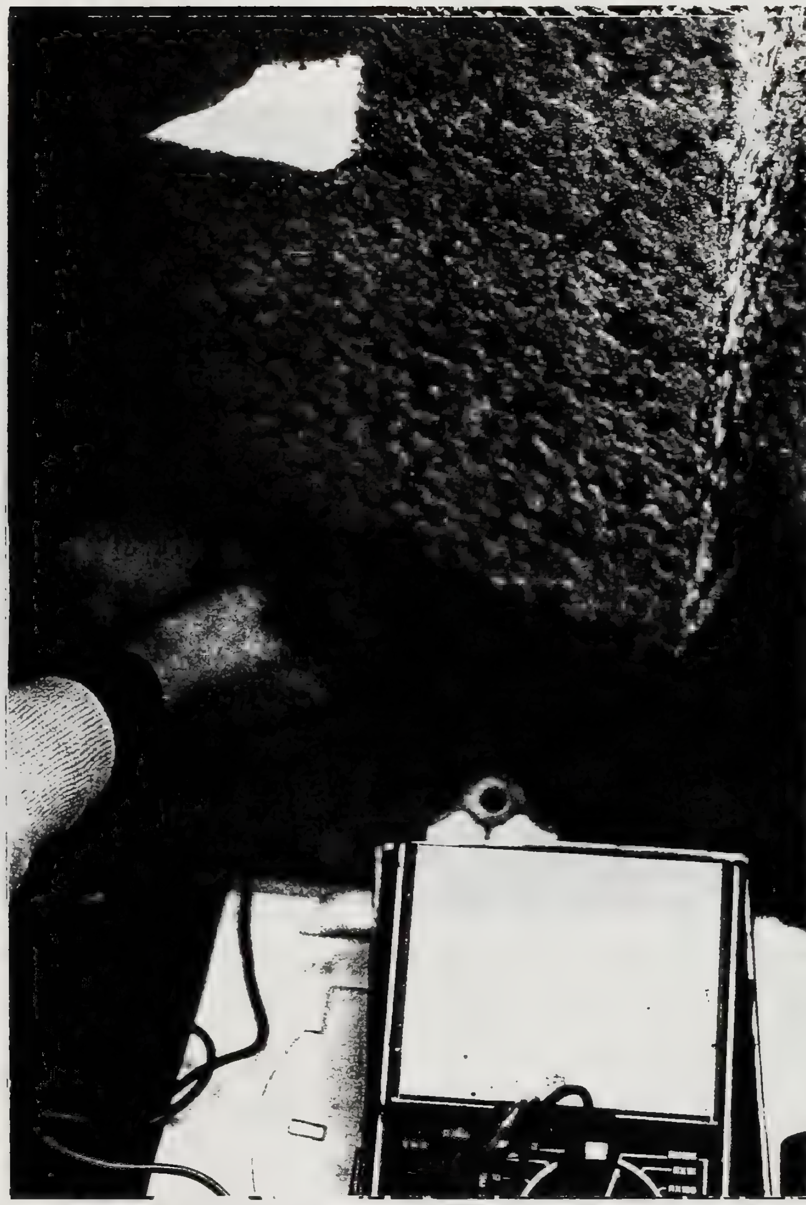


PHOTO P

REPORT

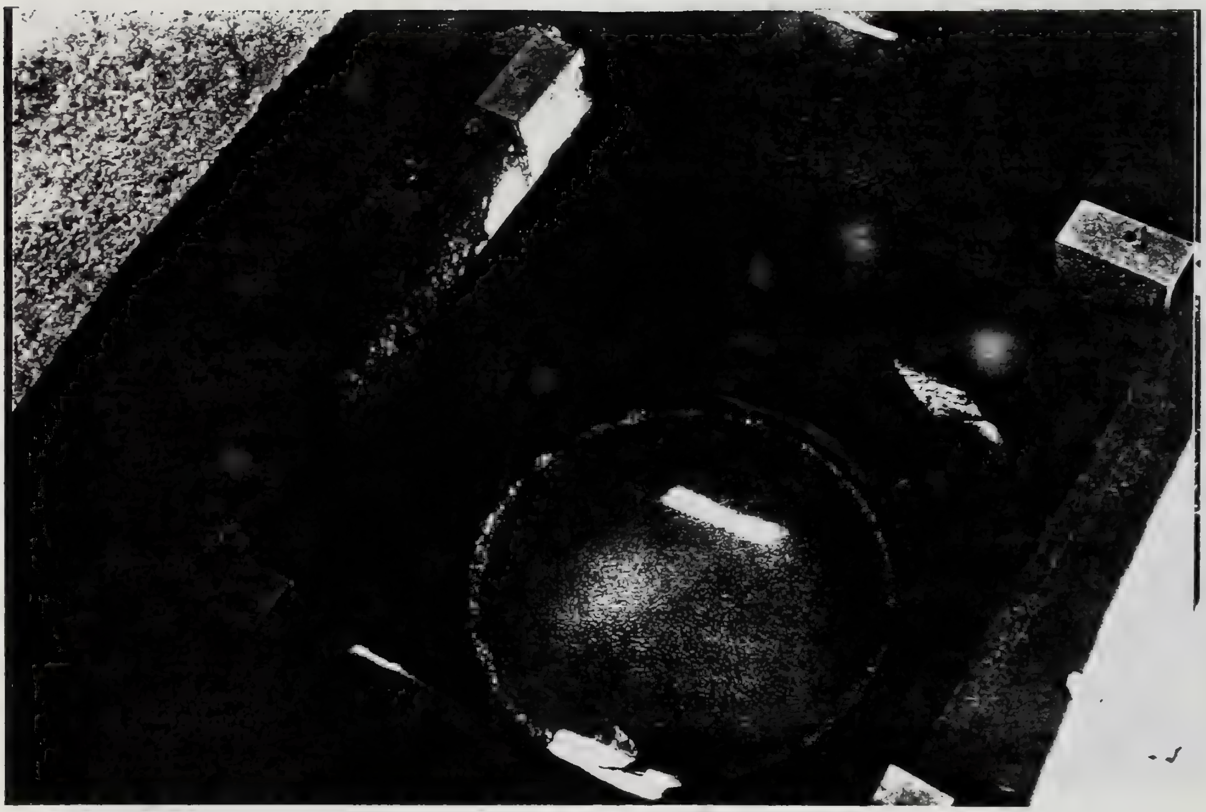


PHOTO Q - 1

REPORT

PHOTO Q - 2

Date: April 26, 1985

File No. 85032

Client: City of San Francisco

REPORT

PHOTO R
Evidence of efflorescence at pour joint in stairway.

REPORT

C. Roof Level

The roof level is categorized by two distinct areas. The first area is the main walking surface (Photo S) and the stairs (Photo T) approaching this area from the landing below. A review of the original details provided indicates that this area is also of a split slab type construction with the final surfacing of a tile paver deck over a mortar bed.

In the main walking area, a membrane has been applied over the paver bed which is peeling and brittle. The exact composition of the membrane is not known but it appears to be a reinforced elastomeric applied over an organic seporator sheet. There was no evidence of adhesion of the separate sheet to the tile paver deck.

Moisture was present in tile surfacing beneath the membrane during our investigation.

The stairwell landing appears to be a split slab type construction with a wood plank surfacing. A walk-through of the area beneath the exterior deck did not indicate any current leakage into the interior. There are also signs of spalling along the stairwell counterflashing which could allow moisture (Photo U) penetration behind the original membrane.

It is unknown why the surfacing membrane was originally installed over the paver walking surface. An assumption would be to correct leaks in this area; however, moisture was present in the original mortar bed and no leakage was observed. It is possible that the surface membrane, although failed, is reducing the volume of water reaching the original membrane, consequently minimizing water entry to the structure.

REPORT

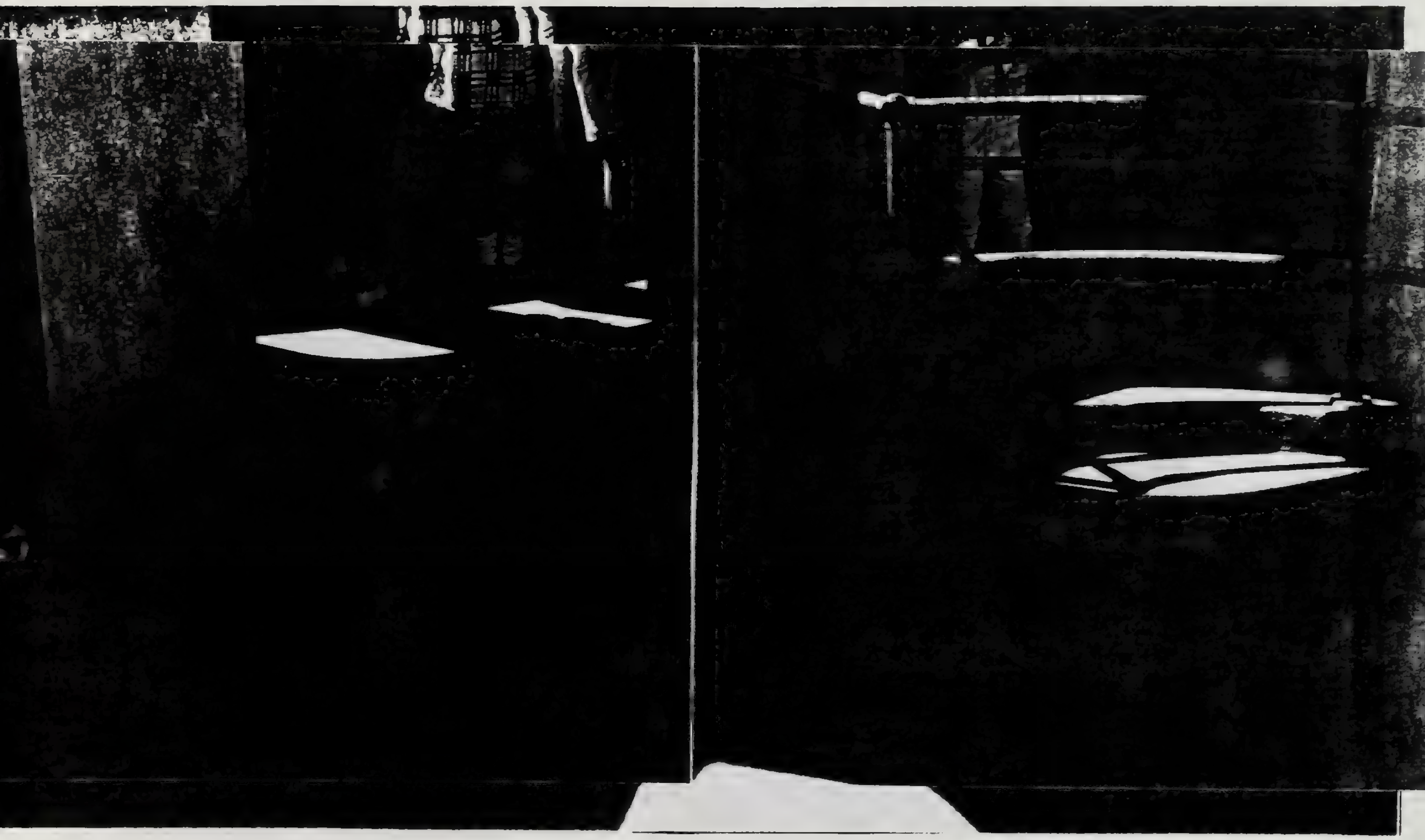


PHOTO S

REPORT

PHOTO T

REPORT

PHOTO U

REPORT

COIT MEMORIAL TOWER

DISCUSSION & CORRECTIVE CONSIDERATIONS

DISCUSSION

° Roof Membrane

A membrane assembly installed over a split slab construction will, in most cases, show premature failure due to trapped moisture and any water entering beneath the system will become trapped between old and new membrane. Also, the intersection of the floating slab and the vertical walls or base flashings is a potential fracture area due to movement differentials.

The roof membrane on the second floor level does not appear to be the main source of leakage in the areas tested. Although the base flashing assembly was not installed with cant strip or additional reinforcing plies to reduce intersection stress, it does not appear to be presenting any significant problem at this time.

The Balustrade Level membrane is in reasonable condition, considering it is also of a split slab type of construction. With the exception of the light boxes and isolated intersection fractures, the existing membrane could be salvaged.

The upper level walk area is the heaviest foot traffic area of all roof assemblies and is disintegrated beyond repair potential. The moisture present in the existing mortar bed would prevent any type of long-term application to the existing paver surface.

In all areas, water entering into the cementatious plaster surfacing could bypass the counterflashing system and result in moisture behind and beneath the membrane assemblies. This would normally be observed as seepage type of leaking. In addition, wall cracks, spalling and construction joints are areas of potential high volume moisture penetration into the structure.

REPORT

COIT MEMORIAL TOWER

DISCUSSION & CORRECTIVE CONSIDERATIONS

° Retrofit Considerations

Ideally, it would be proper to remove the existing membrane assemblies, paver decks, original membrane and install new membranes on the structural slabs. A choice of surfacing could be chosen depending on each individual area's intended use. This would be our long-term recommendation for all areas.

Our roof deck watertest of the second floor level did not produce any leakage into the interior. This would indicate that the potential of salvaging the membrane in these two areas is a consideration to allow for the majority of the roofing funds to be applied to the upper level paver deck area.

In time, it would be necessary to retrofit those areas down to the structural slab in order to provide long-term serviceability.

The second floor roof area could receive base flashing repair and reinforcement, including cant strip installation.

The balustrade roof level could receive elastomeric re-coating and reinforcement. The metal boxes should be repaired or replaced as necessary where rusted.

REPORT

COIT MEMORIAL TOWER

DISCUSSION & CORRECTIVE CONSIDERATIONS

° Wall Considerations

In all areas, the cementatious plaster surfacing appears to be the main source of water entry behind the flashings and consideration should be given as to what type of waterproofing or repellant should be installed to prevent or minimize water entry into the structure.

There are three categories of materials which could be applicable for this project - penetrating water repellants, elastomeric waterproofing, and non-penetrating repellants or surfacing.

Penetrating type water repellants are economical and could be applied to the exterior surfaces after the surfacing repairs and necessary caulking repairs are complete; however, this type of coating would accentuate the plaster repairs and possibly create two conditions. The first would be an unsightly project because of the extent of surface repairs, and the second would be that solvent base repellants often limit the future application of other types of waterproofing.

Elastomeric waterproofing could be applied to all exterior surfaces after repairs are completed and provide the necessary water repellant function as well as aesthetic features. Various manufacturers' materials are available, each with their own significant formulations, elasticity properties and surface preparation methods. One advantage of the elastomerics is their ability to withstand normal thermal changes in the structure. Most of the coatings have good ultraviolet degradation resistance and color retention.

The third consideration for the walls is a water repellant top surfacing. This type of coating is usually applied creating a clear or opaque film on the surface of the plaster surface. This type of material does not allow for thermal or structural movement; however, it is the most economical of the three. The surface type of water repellant is usually a shorter term type of application and would need additional applications more frequently to retain its repellant integrity.

Date: April 26, 1985
File No. 85032
Client: City of San Francisco

REPORT

ANTICIPATED BUDGETS FOR INDIVIDUAL ROOF AREAS

A. Second Floor Roof Area

° Reinforce existing base flashings with cant strip and modified bitumen sheet membrane.
° Install counterflashing where missing.

Budget $6,000.00

B. Balustrade Level

° Apply elastomeric waterproofing over existing system.

Budget $5,000.00

° Repair of existing sheet metal sump pans.

Budget $2,000.00

Note: Does not include steel sump replacement.

C. Roof Level

1. Walking Area:

° Remove existing membrane, tile, mortar bed and original membrane.
° Install sheet applied modified bitumen waterproofing and protection board.
° Install new tile setting bed and walk surface.

Budget $36,000.00

2. Stairwell:

° Prepare surface and install elastomeric coating system with sheet neoprene flashings.

Budget $2,500.00

It would be essential that appropriate wall waterproofing be done in all areas to accomplished a water-tight membrane assembly.

APPENDIX

TEI CONSULTING ENGINEERS
A Division of Testing Engineers, Inc.

RECEIVED
FEB 21 1985
Interactive Resources, Inc.

February 20, 1985

Work Request No. 84292

Interactive Resources
117 Park Place
Pt. Richmond, CA 94801

ATTN: Mr. Paul Weir

SUBJ: Coit Tower Concrete Analysis

Dear Mr. Weir:

At your request, we have conducted tests for the determination of water soluble chloride and sulphate contents on the two concrete samples submitted to our Oakland laboratory. The concrete samples were reportedly removed from the Belvedere level of Coit Tower and were marked as follows:

Sample 1 - Concrete from precast balustrade

Sample 2 - Concrete from exterior column corner

TESTS AND RESULTS

A portion of the concrete sample was pulverized to fine powder. Ten grams of the concrete powder were added to 90 ml. of hot distilled water. The mixture was stirred for 10 minutes with a magnetic stirrer and then filtered. The filtrate was tested for water soluble chloride content using a Quantab Chloride titrator. The water soluble chloride content results as percentage chloride content in concrete and also as ppm of concrete are reported in Table 1.

The concrete samples were also analyzed by wet chemical analysis methods for the qualitative determination of chloride (Cl^-) and sulfate (SO_4^{--}) ions. The results of these tests are reported in Table 2.

ACI committee recommendations for ACI 318-83 (Building Code requirements for reinforced concrete) for chloride content of concrete are given in Table 3.

The chloride content results reported in Table 1 cannot be compared directly to the ACI recommendations given in Table 3. For a direct comparison to be made, it is necessary to know/determine the cement content per cubic yard of concrete.

Please contact the undersigned should you have any questions regarding this report.

Yours truly,

TEI CONSULTING ENGINEERS

Vijain

Dr. Vijay Jain
Materials Engineer

VJ:jkc
Enclosures

TABLE 1

CHLORIDE ION DETERMINATION

Test No.	Water Soluble Chloride Content	Sample 1	Sample 2
1	Percent Chloride (Cl^-) Content in Concrete	0.129	0.247
2	Chloride (Cl^-) content ppm of Concrete	1290	2470

TABLE 2

WET CHEMICAL ANALYSIS RESULTS

Test	Sample 1	Sample 2
Chloride (Cl^-)	Present in small quantity	Present in medium quantity
Sulfate (SO_4^{--})	Present in small quantity	Present in medium quantity

TABLE 3

ACI 318-83 RECOMMENDATIONS FOR CHLORIDE CONTENT OF CONCRETE

Type of Member	Maximum Water Soluble Ion (Cl-) Content in Concrete, % by weight of Cement
Prestressed Concrete	0.06
Reinforced Concrete Exposed to Chloride in Service	0.15
Reinforced Concrete That Will be Dry or Protected from Moisture in Service	1.00
Other Reinforced Concrete Construction	0.30

SOIL INVESTIGATION

DISTRESS OF EXTERIOR SLABS AND WALLS AT COIT TOWER

SAN FRANCISCO, CALIFORNIA

Don Hillebrandt Associates

Don Hillebrandt Associates
Geotechnical Consultants

DONALD H. HILLEBRANDT, C.E
GARY C. CARPENTER, C.E

604 Mission St. Suite 901 • San Francisco, CA 94105 • Phone (415) 543-5943

May 9, 1985
Project 1547-2

Interactive Resources Inc.
117 Park Place
Point Richmond, CA 94801

Attn: Mr. John Clinton

RE: Soil Investigation
Evaluation of Distress of
Exterior Retaining Walls
and Slabs at Coit Tower
San Francisco, California

Gentlemen:

In accordance with your request, we have performed a soil investigation to evaluate the slab settlement and retaining wall rotation problems which have occurred along the western portion of the exterior walkway around Coit Tower in San Francisco, California.

SCOPE OF WORK

The scope of our work, which was outlined in our letter dated March 18, 1985 included a detailed reconnaissance of the site, review of available plans for the retaining walls, subsurface exploration consisting of three exploratory borings, three exploratory probes and two exploratory test pits, laboratory tests, engineering analyses of the field and laboratory data and preparation of this report which summarizes the results of our studies.

SITE INVESTIGATION

Several site reconnaissances were performed by our project engineer during March and April 1985. Our subsurface exploration included (1) drilling three heavily-sampled exploratory borings and three probes through the slabs behind the perimeter retaining walls to evaluate the thickness and quality of the wall backfill materials and (2) excavating two exploratory test pits in front of the walls to evaluate the depths of the retaining wall footings. Our subsurface exploration work was performed on March 25 and 26, 1985 under the direction of our project engineer. The borings/probes were drilled and the test pits were excavated at the approximate locations shown on the Site Plan, Figure 1. Logs of our borings and test pits as well as details regarding our field and laboratory investigations are presented in the attached Appendix A.

A. SITE FEATURES

Coit Tower is located at the top of Telegraph Hill in San Francisco. The circular-shaped concrete tower was constructed in the 1930's and is surrounded by a perimeter walkway which is about 6 to 8 feet above the surrounding grades. The walkway was developed by constructing retaining walls about 6 to 7 feet outboard of the tower, then backfilling behind the walls and constructing a slab-on-grade walkway on the backfill material. Although accurate plans for the perimeter concrete retaining walls are not available, it is our understanding that the walls were most probably designed as gravity-type retaining walls. Although the majority of the walls and slabs around the perimeter of the tower are in relatively good condition considering their age, significant settlement (up to about 2 inches) and cracking of the slabs has occurred on the western side of the tower. In addition, the retaining walls in this area have rotated outward by as much as one inch.

B. SUBSURFACE CONDITIONS

The Geologic Map of the San Francisco North Quadrangle (U.S.G.S., 1974) indicates that the site is underlain by Franciscan Formation sandstone bedrock materials. These sandstone bedrock materials were observed in the cut slope immediately to the east of the tower.

Exploratory Borings 1 and 2, which were drilled on the western side of the tower in the area of the distressed slabs and rotated retaining wall, encountered 9½ to 11½ feet of loose fill. The loose fill consisted primarily of broken sandstone rock fragments which were probably obtained from excavations made in conjunction with construction of the tower or associated roadways. Based on our laboratory tests, the broken sandstone fill has been classified as a clayey sandy gravel-gravelly clayey sand. In both borings, the fill materials were directly underlain by fractured sandstone bedrock materials which extended to the depths of the borings (10½ and 12½ feet in Borings 1 and 2, respectively). Exploratory Probes 1 and 2, which were drilled about midway between the borings and the wall (see Figure 1) encountered refusal at depths of 8 feet and 5½ feet, respectively. Since refusal was encountered at shallower depths than in the borings, it is our opinion that the probes probably encountered refusal in the battered portion of the adjacent concrete gravity retaining wall.

Boring 3, which was drilled on the eastern side of the tower in an area which does not appear to be experiencing any distress, encountered 2½ feet of loose fill. The fill consisted of clayey sand with rock fragments and was underlain by fractured sandstone bedrock which continued to the depth of the boring (4 feet). Probe 3, which was drilled between Boring 3 and the wall, encountered refusal in sandstone bedrock materials at a depth of 4½ feet.

Exploratory Test Pits 1 and 2 were hand-excavated in front of the wall on the western side of the tower as shown on Figure 1. Both test pits encountered loose broken rock fill materials which extended to the bottom of the wall footings, approximately 5 feet below the adjacent grade. Fractured sandstone bedrock was encountered immediately below the fill materials and at both test pit locations the wall footings were bearing on these fractured sandstone bedrock materials. The face of the concrete wall had been formed to the bottom of the footing and old, rotted form boards were encountered in our test pit excavations.

Detailed descriptions of the materials encountered in our borings and test pits are shown on the boring and test pit logs in the attached Appendix A. These boring/test pit logs and related information depict subsurface conditions only at the specific locations shown on the Site Plan and on the dates designated on the logs. Subsurface conditions at other locations and times will differ somewhat from the conditions occurring at our boring, probe and test pit locations.

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

We have evaluated the slab settlement/cracking and retaining wall rotation problems discussed above and our conclusions and recommendations are presented below:

(1) Settlement/Cracking of Slabs-on-Grade

The wall backfill materials encountered in all of our borings were classified as loose, based on the penetration resistance "blow counts" which were obtained during the driving of our samplers. In addition, a comparison of the in-place dry densities of the wall backfill materials with the maximum dry density determined from our laboratory compaction curve indicated that the relative compactions of all of the fill samples were less than 90 percent and half of the samples tested had a relative compaction of 80 percent or less. In addition, we wish to note that the slabs on the eastern side of the tower have settled up to 2 inches and in order for this settlement to take place, densification of the backfill would have to had occurred. As a result, it is likely that the relative compaction of the backfill materials beneath the slabs shortly after construction is even lower than that measured by our recent field and laboratory tests.

Based on our studies, it is our opinion that the observed settlement and cracking of the exterior slabs-on-grade on the western side of the tower has resulted from consolidation of the 9½ to 11½ feet of loose backfill materials under their own weight and the weight of the overlying slabs. Although the backfill materials encountered in Boring 3 (drilled on the eastern side of the tower) were also in a "loose" condition, only about 2 feet of fill was encountered in this boring and this probably accounts for the lack of significant cracking or settlement of the slabs in this area.

In order to prevent further settlement of the fill (and overlying slabs-on-grade) on the western side of the tower, the fill would have to be over-excavated for its full depth and recompacted in thin lifts to at least 90 percent relative compaction (ASTM D1557). Alternatively, the fill could be left in place and the existing slab-on-grade replaced with a structural slab which spans between the tower and the retaining wall (providing that this could be handled structurally).

(2) Rotation of Exterior Retaining Walls

In our opinion, the observed rotation of the retaining wall on the western side of the tower probably resulted from a combination of factors. Retaining walls are often designed for "active" wall pressures. In order for these pressures to develop, the wall must be unrestrained and free to yield slightly at the top. Yielding of the tops of unrestrained walls equal to ½ percent of the wall height is not uncommon and this yielding could account for some of the observed rotation.

Another possible contributing factor is the lack of wall drainage. No weep holes are present at the base of the walls and no evidence of a conventional aggregate "back drain" was observed in any of our borings or probes. Although no water was encountered in our borings, surface water runoff may pond in areas where significant settlement of the slabs behind the walls has occurred and this surface water may have infiltrated the wall backfill through cracks in the slabs. Such water infiltration would result in increased pressure (seepage/hydrostatic) against the retaining walls and may be a factor in the observed wall rotation.

Recommended design pressures for the following three different backfill conditions are presented below in Table I: (1) existing uncompacted backfill with weep holes drilled at the base of the wall, (2) wall backfill recompacted to 90% relative compaction (ASTM D1557) and wall backdrain installed, and (3) existing backfill removed and replaced with compacted lightweight backfill and a wall backdrain installed.

TABLE I - DESIGN WALL PRESSURES

WALL BACKFILL	UNRESTRAINED WALLS	RESTRAINED WALLS	REMARKS
Existing Loose Fill	45 PCF	55 PCF	Assumes weep holes are drilled through the base of the wall at 6-foot centers
Over-excavate and Recompact Existing Backfill to 90% (ASTM D1557)	35 PCF	45 PCF	*Assumes backdrain is installed behind wall
Remove Existing Fill and Replace with **Lightweight Fill Compacted to 90% (ASTM D1557)	20 PCF	25 PCF	*Assumes backdrain is installed behind wall

*A conventional wall backdrain typically would consist of a 4-inch diameter perforated pipe bedded in filter material (well-graded mixture of sand and gravel) which is at least 1 foot in width and extends to within 1 foot of the slab behind the wall.

**Lightweight fill should have a maximum in-place unit weight of 70 pounds per cubic foot.

Lateral loads may be resisted by friction between the wall foundation bottoms and the underlying bedrock materials; we recommend a coefficient of friction of 0.5 be used to evaluate lateral resistance against sliding. Because of the loose nature of the fill materials in front of the wall, we recommend that no passive pressures be used in the structural analysis of the walls.

LIMITATIONS

Our services consist of professional opinions, conclusions and recommendations that are made in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

If you have any questions regarding this report, please call us.

Very truly yours,

DON HILLEBRANDT ASSOCIATES

Donald H. Hillebrandt
C. E. 16338

GCC/DHH/mk

Enclosures: Figure 1 - Site Plan
Appendix A - Field and Laboratory Investigations
Figure A-1 - Key to Exploratory Boring and Test Pit Logs
Exploratory Boring Logs 1, 2 and 3
Figure A-2 - Logs of Exploratory Test Pits
Figure A-3 - Gradation Test Data

Copies: Addressee (2)

APPENDIX A - FIELD AND LABORATORY INVESTIGATIONS

FIELD INVESTIGATION

Our field investigation consisted of a site reconnaissance and subsurface exploration performed by our engineer on March 25 and 26, 1985. Three 3-inch diameter exploratory borings and three probe borings were drilled with a portable power auger rig behind the retaining walls at the approximate locations shown on Figure 1. In addition, exploratory test pits were hand-excavated at two locations in front of the retaining wall to determine the depth of the wall footing and the bearing material; the approximate locations of our test pits are also shown on Figure 1. Logs of our exploratory borings as well as a key for the classification of the soils encountered in the borings and test pits, Figure A-1, are included as part of this appendix. Cross-sections of our test pits are included on Figure A-2 of this appendix.

Representative relatively undisturbed soil samples were obtained from the exploratory borings at selected depths appropriate to the subsurface investigation. The undisturbed samples were obtained with a Modified California Sampler (2-Inch I.D.) which is designated by ◨ on the attached boring logs.

Blow counts recorded on the boring logs were obtained with the Modified California Sampler by dropping a 140-pound hammer through a 30-inch free fall. The sampler was driven 18 inches, or a shorter distance where hard resistance was encountered, and the number of blows were recorded for each 6 inches of penetration. The blows per foot recorded on the boring logs have been adjusted to represent the Standard Penetration Test; they are the adjusted number of blows by the Standard Penetration Test required to drive the sampler the last 12 inches or the number of inches indicated where the sampler did not penetrate the full 18 inches.

Topographic data was not available at the time of our field work; as a result, the ground surface elevations at the locations of our exploratory borings and test pits were not established.

The boring and test pit logs show our interpretation of the subsurface conditions on the dates and at the locations indicated and it is not warranted that they are representative of the subsurface conditions at other locations and times. Also, the stratification lines represent the approximate boundaries between the material types; actual transitions are gradual.

LABORATORY INVESTIGATION

The laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the materials underlying the site.

The natural water content was determined on 8 samples of the materials recovered from the borings; these water contents are recorded on the boring logs at the appropriate sample depths.

Dry density determinations were made on 7 samples of the materials recovered from the borings; the results of these tests are presented on the logs of borings at the appropriate sample depths.

The percentage of particles passing the No. 200 sieve was determined on 3 samples of the materials obtained from the borings. These tests were performed to assist in the classification of the soils. The results of these tests are also presented on the logs of borings at the appropriate sample depths.

A gradation test was performed on a representative sample of the wall backfill material. This test was performed to assist in classification of the soil and to determine the grain size distribution. The results of this test are presented on Figure A-3.

A laboratory compaction test (ASTM D1557-70 Method) was performed on a bulk sample of the wall backfill materials obtained from Boring 2. This test was performed to determine the maximum dry density and optimum water content of the existing backfill materials. The results of this test indicate a maximum dry density of 131 pounds per cubic foot at an optimum moisture content of 9 percent.

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO 200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GRAVEL WITH FINES	GM	Silty gravels gravel-sand-silt mixtures non-plastic fines
			GC	Clayey gravels gravel-sand-clay mixtures plastic fines
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands gravelly sands little or no fines
			SP	Poorly graded sands or gravelly sands little or no fines
		SANDS WITH FINES	SM	Silty sands sand-silt mixtures non-plastic fines
			SC	Clayey sands sand-clay mixtures plastic fines
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts micaceous or diatomaceous fine sandy or silty soils elastic silts
			CH	Inorganic clays of high plasticity fat clays
			OH	Organic clays of medium to high plasticity organic silts
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils

DEFINITION OF TERMS

U S STANDARD SERIES SIEVE — 200, 40, 10, 4

CLEAR SQUARE SIEVE OPENINGS — 3/4", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

GRAIN SIZES

SANDS AND GRAVELS	BLOWS/FOOT†
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

SILTS AND CLAYS	STRENGTH‡	BLOWS/FOOT†
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

† Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586)

‡ Unconfined compressive strength in tons/sq ft as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586) pocket penetrometer torvane or visual observation

Don Hillebrandt Associates
Geotechnical Consultants

KEY TO EXPLORATORY BORING AND TEST PIT LOGS
Unified Soil Classification System (ASTM D-2487)

Exterior Slabs/Walls at Coit Tower
San Francisco, California

PROJECT NO	DATE	
1547-2	May 1985	Figure A-1

DRILL RIG	Portable Power Auger	SURFACE ELEVATION	See Note 1	LOGGED BY	FP
DEPTH TO GROUNDWATER	See Note 2	BORING DIAMETER	3 Inches	DATE DRILLED	3-25-85

DESCRIPTION AND CLASSIFICATION: DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DRY DENSITY (PCF)	SHEAR STRENGTH (KSF)
Concrete Slab									
Clayey Sandy Gravel - Gravelly Clayey Sand (Broken Sandstone Fill)	Brown and Yellow Brown	Loose	SC-GC			7	12	103	
Passing #200 Sieve = 10%				2					
				4		12	13	97	
				6		5			
				8					
(FILL)									
Fractured Sandstone	Yellow Brown	Dense to V.Dense	-			45/9"	9	116	
Drill Rig Refusal at 10½ Feet				10					

Bottom of Boring = 10½ Feet

NOTES:

(1) Topographic data was not available at the time of our field work.

(2) Boring was dry at the time of drilling and was backfilled immediately (see text of report for discussion of groundwater).

(3) Stratification lines represent approximate boundaries between material types; actual transitions are gradual.

Don Hillebrandt Associates
Geotechnical Consultants

EXPLORATORY BORING LOG

Exterior Slabs/Walls at Coit Tower
San Francisco, California

PROJECT NO.	DATE	BORING NO.
1547-2	May 1985	1

DRILL RIG Portable Power Auger	SURFACE ELEVATION See Note 1	LOGGED BY FP
DEPTH TO GROUNDWATER See Note 2	BORING DIAMETER 3 Inches	DATE DRILLED 3-25-85

DESCRIPTION AND CLASSIFICATION				DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DRY DENSITY (PCF)	SHEAR STRENGTH (KSF)
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE						
Concrete Slab									
Clayey Sandy Gravel - Gravelly Clayey Sand (Broken Sandstone Fill)	Brown and Yellow Brown	Loose	SC GC			6	11	104	
Passing #200 Sieve = 22%				2					
				4		5			
				6					
Passing #200 Sieve = 15%						8	9		
				8					
				10		8			
(FILL)									
Fractured Sandstone	Yellow Brown	Very Dense	-	12		38/5"	7	110	

Bottom of Boring = 12½ Feet

NOTES:

(1) Topographic data was not available at the time of our field work.

(2) Boring was dry at the time of drilling and was backfilled immediately (see text of report for discussion of groundwater).

(3) Stratification lines represent approximate boundaries between material types; actual transitions are gradual.

Don Hillebrandt Associates
Geotechnical Consultants

EXPLORATORY BORING LOG

Exterior Slabs/Walls at Coit Tower
San Francisco, California

PROJECT NO.	DATE	BORING NO.
1547-2	May 1985	2

DRILL RIG Portable Power Auger	SURFACE ELEVATION See Note 1	LOGGED BY FP
DEPTH TO GROUNDWATER See Note 2	BORING DIAMETER 3 Inches	DATE DRILLED 3-25-85

DESCRIPTION AND CLASSIFICATION				DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DRY DENSITY (PCF)	SHEAR STRENGTH (KSF)
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE						
Concrete Slab									
Clayey Sand with Gravel-Sized Rock Fragments (FILL)	Brown	Loose	SC	2		5	9	115	
Fractured Sandstone	Yellow Brown	Very Dense		4		66/12"	7	127	

Bottom of Boring = 4 Feet

NOTES:

(1) Topographic data was not available at the time of our field work.

(2) Boring was dry at the time of drilling and was backfilled immediately (see text of report for discussion of groundwater).

(3) Stratification lines represent approximate boundaries between material types; actual transitions are gradual.

Don Hillebrandt Associates
Geotechnical Consultants

EXPLORATORY BORING LOG

Exterior Slabs/Walls at Coit Tower
San Francisco, California

PROJECT NO.	DATE	BORING NO.
1547-2	May 1985	3

Exhibit DD

EXHIBIT DD.

BUREAU OF ARCHITECTURE
CITY AND COUNTY OF SAN FRANCISCO

INFORMATION ON COIT TOWER

Exhibit EE

EXHIBIT EE.

BUREAU OF ARCHITECTURE
DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF SAN FRANCISCO

SPECIFICATIONS AND DRAWINGS FOR
COIT TOWER RESTORATION
(REPAIRS, COATING, ROOFING, AND ELEVATOR WORK)
JUNE 1986

(INCLUDED IS A SYNOPSIS OF
OMISSIONS AND CHANGES)

Exhibit FF

EXHIBIT FF.

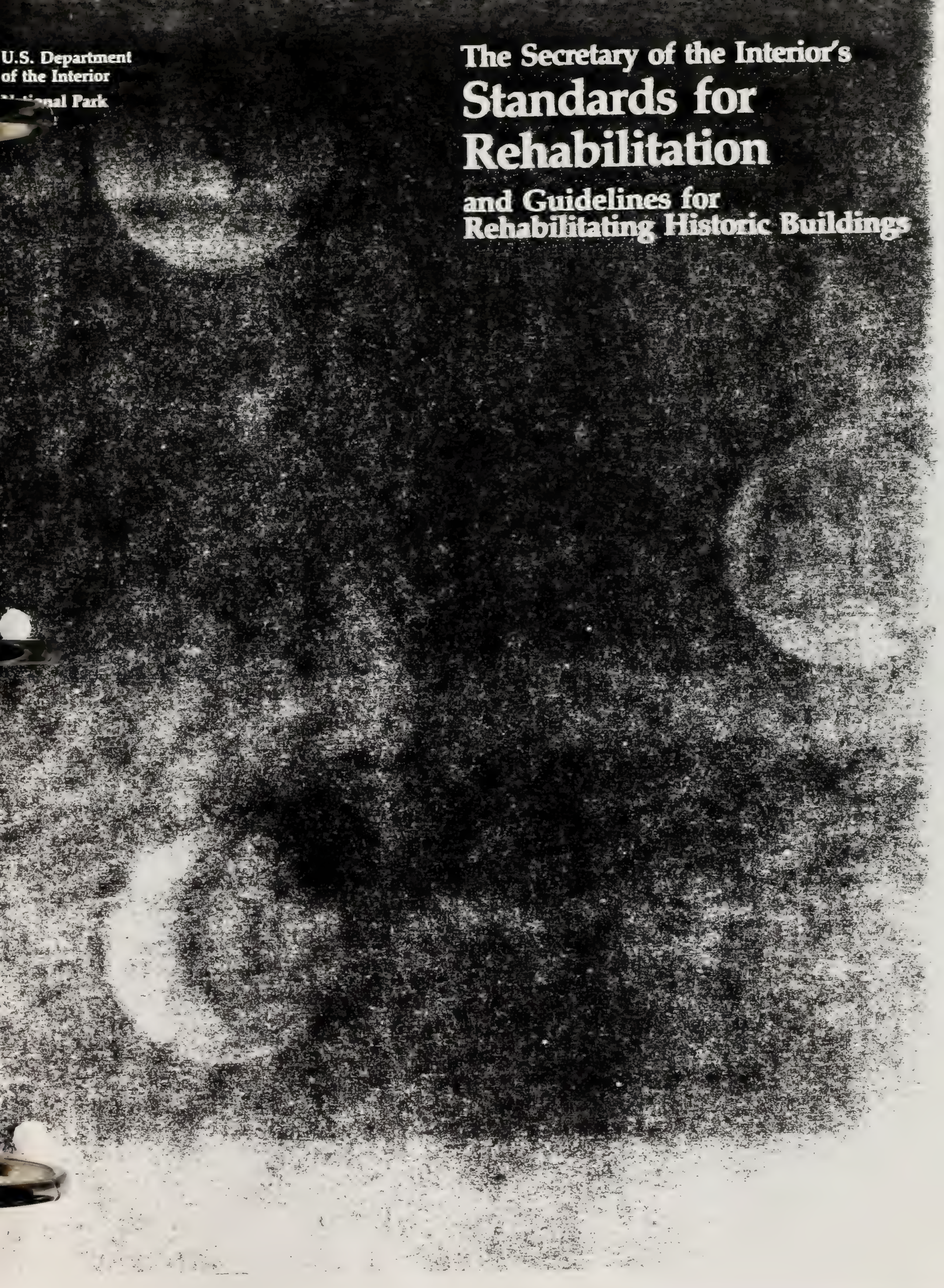
THE SECRETARY OF THE INTERIOR'S STANDARDS FOR REHABILITATION AND GUIDELINES FOR REHABILITATING HISTORIC BUILDINGS (REVISED 1983)

U.S. DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE PRESERVATION ASSISTANCE DIVISION WASHINGTON, D.C.

U.S. Department
of the Interior
National Park

The Secretary of the Interior's Standards for Rehabilitation

and Guidelines for Rehabilitating Historic Buildings



The Secretary of the Interior's

Standards for Rehabilitation

and Guidelines for

Rehabilitating Historic Buildings (Revised 1983)

U.S. Department of the Interior
National Park Service
Preservation Assistance Division
Washington, D.C.

The "Secretary of the Interior's Standards for Historic Preservation Projects" were initially prepared in 1979 by W. Brown Morton III and Gary L. Hume. The updated and expanded Guidelines for Rehabilitating Historic Buildings that follow were developed by Gary L. Hume and Kay D. Weeks, Technical Preservation Services, Preservation Assistance Division, with the assistance of the professional and support staff.

CONTENTS

THE SECRETARY OF THE INTERIOR'S STANDARDS FOR REHABILITATION

The Secretary of the Interior is responsible for establishing standards for all programs under Departmental authority and for advising Federal agencies on the preservation of historic properies listed or eligible for listing in the National Register of Historic Places. In partial fulfillment of this responsibility, the Secretary of the Interior's Standards for Historic Preservation Projects have been developed to direct work undertaken on historic buildings.

Initially used by the Secretary of the Interior in determining the applicability of proposed project work on registered properties within the Historic Preservation Fund grant-in-aid program, the Standards for Historic Preservation Projects have received extensive testing over the years--more than 6,000 acquisition and development projects were approved for a variety of work treatments. In addition, the Standards have been used by Federal agencies in carrying out their historic preservation responsibilities for properties in Federal ownership or control; and by State and local officials in the review of both Federal and nonfederal rehabilitation proposals. They have also been adopted by a number of historic district and planning commissions across the country.

The Standards for Rehabilitation (36 CFR 67) comprise that section of the overall historic preservation project standards addressing the most prevalent treatment today: Rehabilitation. **"Rehabilitation" is defined as the process of returning a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural, and cultural values.**

The Standards for Rehabilitation are as follows:

1. Every reasonable effort shall be made to provide a compatible use for a property which requires minimal alteration of the building, structure, or site and its environment, or to use a property for its originally intended purpose.

2. The distinguishing original qualities or character of a building, structure, or site and its environment shall not be destroyed. The removal or alteration of any historic material or distinctive architectural features should be avoided when possible.

3. All buildings, structures, and sites shall be recognized as products of their own time. Alterations that have no historical basis and which seek to create an earlier appearance shall be discouraged.

4. Changes which may have taken place in the course of time are evidence of the history and development of a building, structure, or site and its environment. These changes may have acquired significance in their own right, and this significance shall be recognized and respected.

5. Distinctive stylistic features or examples of skilled craftsmanship which characterize a building, structure, or site shall be treated with sensitivity.

6. Deteriorated architectural features shall be repaired rather than replaced, wherever possible. In the event replacement is necessary, the new material should match the material being replaced in composition, design, color, texture, and other visual qualities. Repair or replacement of missing architectural features should be based on accurate duplications of features, substantiated by historic, physical, or pictorial evidence rather than on conjectural designs or the availability of different architectural elements from other buildings or structures.

7. The surface cleaning of structures shall be undertaken with the gentlest means possible. Sandblasting and other cleaning methods that will damage the historic building materials shall not be undertaken.

8. Every reasonable effort shall be made to protect and preserve archeological resources affected by, or adjacent to any project.

9. Contemporary design for alterations and additions to existing properties shall not be discouraged when such alterations and additions do not destroy significant historical, architectural or cultural material, and such design is compatible with the size, scale, color, material, and character of the property, neighborhood or environment.

10. Wherever possible, new additions or alterations to structures shall be done in such a manner that if such additions or alterations were to be removed in the future, the essential form and integrity of the structure would be unimpaired.

In the past several years, the most frequent use of the Secretary's "Standards for Rehabilitation" has been to determine if a rehabilitation project qualifies as a "certified rehabilitation" pursuant to the Tax Reform Act of 1976, the Revenue Act of 1978, and the Economic Recovery Tax Act of 1981, as amended. The Secretary is required by law to certify rehabilitations that are "consistent with the historic character of the structure or the district in which it is located." The Standards are used to evaluate whether the historic character of a building is preserved in the process of rehabilitation. Between 1976 and 1982 over 5,000 projects were reviewed and approved under the Preservation Tax Incentives program.

As stated in the definition, the treatment "Rehabilitation" assumes that at least some repair or alteration of the historic building will need to take place in order to provide for an efficient contemporary use; however these repairs and alterations must not damage or destroy the materials and features—including their finishes—that are important in defining the building's historic character.

In terms of specific project work, preservation of the building and its historic character is based on the assumption that (1) the historic materials and features and their unique craftsmanship are of primary importance and that (2), in consequence they will be retained, protected, and repaired in the process of rehabilitation to the greatest extent possible, not removed and replaced with materials and features which appear to be historic, but which are--in fact--new.

To best achieve these preservation goals, a two-part evaluation needs to be applied by qualified historic preservation professionals for each project as follows: first, a particular property's materials and features which are important in defining its historic character should be identified. Examples may include a building's walls, cornice, window sash and frames and roof; rooms, hallways, stairs, and mantels; or a site's walkways, fences, and gardens. The second part of the evaluation should consist of assessing the potential impact of the work necessary to make possible an efficient contemporary use. A basic assumption in this process is that the historic character of each property is unique and therefore proposed rehabilitation work will necessarily have a different effect on each property; in other words, what may be acceptable for one project may be unacceptable for another. However, the requirement set forth in the definition of "Rehabilitation" is always the same for every project: those portions and features of the property which are significant to its historic, architectural, and cultural values must be preserved in the process of rehabilitation. To accomplish this, all ten of the Secretary of the Interior's "Standards for Rehabilitation" must be met.

GUIDELINES FOR REHABILITATING HISTORIC BUILDINGS

The Guidelines were initially developed in 1977 to help property owners, developers, and Federal managers apply the Secretary of the Interior's "Standards for Rehabilitation" during the project planning stage by providing general design and technical recommendations. Unlike the Standards, the Guidelines are not codified as program requirements. Together with the "Standards for Rehabilitation" they provide a model process for owners, developers, and federal agency managers to follow.

It should be noted at the outset that the Guidelines are intended to assist in applying the Standards to projects generally; consequently, they are not meant to give case-specific advice or address exceptions or rare instances. For example, they cannot tell an owner or developer which features of their own historic building are important in defining the historic character and must be preserved--although examples are provided in each section---or which features could be altered, if necessary, for the new use. This kind of careful case-by-case decisionmaking is best accomplished by seeking assistance from qualified historic preservation professionals in the planning stage of the project. Such professionals include architects, architectural historians, historians, archeologists, and others who are skilled in the preservation, rehabilitation, and restoration of historic properties.

The Guidelines pertain to historic buildings of all sizes, materials, occupancy, and construction types; and apply to interior and exterior work as well as new exterior additions. Those approaches, treatments, and techniques that are consistent with the Secretary of the Interior's "Standards for Rehabilitation" are listed in the **"Recommended"** column on the left; those approaches, treatments, and techniques which could adversely affect a building's historic character are listed in the **"Not Recommended"** column on the right.

To provide clear and consistent guidance for owners, developers, and federal agency managers to follow, the "Recommended" courses of action in each section are listed in order of historic preservation concerns so that a rehabilitation project may be successfully planned and completed--one that, first, assures the preservation of a building's important or "character-defining" architectural materials and features and, second, makes possible an efficient contemporary use. Rehabilitation guidance in each section begins with protection and maintenance, that work which should be maximized in every project to enhance overall preservation goals. Next, where some deterioration is present, repair of the building's historic materials and features is recommended. Finally, when deterioration is so extensive that repair is not possible, the most problematic area of work is considered: replacement of historic materials and features with new materials.

To further guide the owner and developer in planning a successful rehabilitation project, those complex design issues dealing with new use requirements such as alterations and additions are highlighted at the end of each section to underscore the need for particular sensitivity in these areas.

Identify, Retain, and Preserve

The guidance that is basic to the treatment of all historic buildings--**identifying, retaining, and preserving** the form and detailing of those architectural materials and features that are important in defining the historic character-- is always listed first in the "Recommended" column. The parallel "Not Recommended" column lists the types of actions that are most apt to cause the diminution or even loss of the building's historic character. It should be remembered, however, that such loss of character is just as often caused by the cumulative effect of a series of actions that would seem to be minor interventions. Thus, the guidance in all of the "Not Recommended" columns must be viewed in that larger context, e.g., for the total impact on a historic building.

Protect and Maintain

After identifying those materials and features that are important and must be retained in the process of rehabilitation work, then **protecting and maintaining** them are addressed. Protection generally involves the least degree of intervention and is preparatory to other work. For example, protection includes the maintenance of historic material through treatments such as rust removal, caulking, limited paint removal, and re-application of protective coatings; the cyclical cleaning of roof gutter systems; or installation of fencing, protective plywood, alarm systems and other temporary protective measures. Although a historic building will usually require more extensive work, an overall evaluation of its physical condition should always begin at this level.

Repair

Next, when the physical condition of character-defining materials and features warrants additional work **repairing** is recommended. Guidance for the repair of historic materials such as masonry, wood, and architectural metals again begins with the least degree of intervention possible such as patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading them according to recognized preservation methods. Repairing also includes the limited replacement in kind--or with compatible substitute material--of extensively deteriorated or missing parts of features when there are surviving prototypes (for example, brackets, dentils, steps, plaster, or portions of slate or tile roofing). Although using the same kind of material is always the preferred option, substitute material is acceptable if the form and design as well as the substitute material itself convey the visual appearance of the remaining parts of the feature and finish.

Replace

entire feature in kind, that is, with the same material. Because this approach may not always be technically or economically feasible, provisions are made to consider the use of a compatible substitute material.

It should be noted that, while the National Park Service guidelines recommend the replacement of an entire character-defining feature under certain well-defined circumstances, they never recommend removal and replacement with new material of a feature that--although damaged or deteriorated--could reasonably be repaired and thus preserved.

Design for Missing Historic Features

When an entire interior or exterior feature is missing (for example, an entrance, or cast iron facade; or a principal staircase), it no longer plays a role in physically defining the historic character of the building unless it can be accurately recovered in form and detailing through the process of carefully documenting the historical appearance. Where an important architectural feature is missing, its recovery is always recommended in the guidelines as the first or preferred, course of action. Thus, if adequate historical, pictorial, and physical documentation exists so that the feature may be accurately reproduced, and if it is desireable to re-establish the feature as part of the building's historical appearance, then designing and constructing a new feature based on such information is appropriate. However, a second acceptable option for the replacement feature is a new design that is compatible with the remaining character-defining features of the historic building. The new design should always take into account the size, scale, and material of the historic building itself and, most importantly, should be clearly differentiated so that a false historical appearance is not created.

Alterations/Additions to Historic Buildings

Some exterior and interior alterations to the historic building are generally needed to assure its contined use, but it is most important that such alterations do not radically change, obscure, or destroy character-defining spaces, materials, features, or finishes. Alterations may include providing additional parking space on an existing historic building site; cutting new entrances or windows on secondary elevations; inserting an additional floor; installing an entirely new mechanical system; or creating an atrium or light well. Alterations may also include the selective removal of buildings or other features of the environment or building site that are intrusive and therefore detract from the overall historic character.

The construction of an exterior addition to a historic building may seem to be essential for the new use, but it is emphasized in the guidelines that such new additions should be avoided, if possible, and considered only after it is determined that those needs cannot be met by altering secondary, i.e., non character-defining interior spaces. If, after a thorough evaluation of interior solutions, an exterior addition is still judged to be the only viable alternative, it should be designed and constructed to be clearly differentiated from the historic building and so that the character-defining features are not radically changed, obscured, damaged, or destroyed.

Additions to historic buildings are referenced within specific sections of the guidelines such as Site, Roof, Structural Systems, etc., but are also considered in more detail in a separate section, NEW ADDITIONS TO HISTORIC BUILDINGS.

Health and Safety Code Requirements; Energy Retrofitting

These sections of the rehabilitation guidance address work done to meet health and safety code requirements (for example, providing barrier-free access to historic buildings); or retrofitting measures to conserve energy (for example, installing solar collectors in an unobtrusive location on the site). Although this work is quite often an important aspect of rehabilitation projects, it is usually not part of the overall process of protecting or repairing character-defining features; rather, such work is assessed for its potential negative impact on the building's historic character. For this reason, particular care must be taken not to radically change, obscure, damage, or destroy character-defining materials or features in the process of rehabilitation work to meet code and energy requirements.

Specific information on rehabilitation and preservation technology may be obtained by writing to the National Park Service, at the addresses listed below:

Preservation Assistance Division
National Park Service
Department of the Interior
Washington, D.C. 20240

Preservation Services Division
Southeast Regional Office
National Park Service
75 Spring St. SW., Room 1140
Atlanta, GA 30303

National Historic Preservation Programs
Western Regional Office
National Park Service
450 Golden Gate Ave.
Box 36063
San Francisco, CA 94102

Office of Cultural Programs
Mid-Atlantic Regional Office
National Park Service
143 S. Third St.
Philadelphia, PA 19106

Division of Cultural Resources
Rocky Mountain Regional Office
National Park Service
655 Parfet St.
P.O. Box 25287
Denver, CO 80225

Cultural Resources Division
Alaska Regional Office
National Park Service
2525 Gambell St.
Anchorage, AK 99503

BUILDING EXTERIOR

Masonry: Brick, stone, terra cotta, concrete, adobe, stucco and mortar

Masonry features (such as brick cornices and door pediments, stone window architraves, terra cotta brackets and railings) as well as masonry surfaces (modelling, tooling, bonding patterns, joint size, and color) may be important in defining the historic character of the building. It should be noted that while masonry is among the most durable of historic building materials, it is also the most susceptible to damage by improper maintenance or repair techniques and by harsh or abrasive cleaning methods. Most preservation guidance on masonry thus focuses on such concerns as cleaning and the process of repointing. For specific guidance on this subject, consult Preservation Briefs: 1, 2, 5, 6, and 7. (See Reading List and Ordering Information on pg. 58.)

Recommended	Not Recommended
Identifying, retaining, and preserving masonry features that are important in defining the overall historic character of the building such as walls, brackets, railings, cornices, window architraves, door pediments, steps, and columns; and joint and unit size, tooling and bonding patterns, coatings, and color.	Removing or radically changing masonry features which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Replacing or rebuilding a major portion of exterior masonry walls that could be repaired so that, as a result, the building is no longer historic and is essentially new construction. Applying paint or other coatings such as stucco to masonry that has been historically unpainted or uncoated to create a new appearance. Removing paint from historically painted masonry. Radically changing the type of paint or coating or its color.
Protecting and maintaining masonry by providing proper drainage so that water does not stand on flat, horizontal surfaces or accumulate in curved decorative features.	Failing to evaluate and treat the various causes of mortar joint deterioration such as leaking roofs or gutters, differential settlement of the building, capillary action, or extreme weather exposure.

Recommended	Not Recommended
Cleaning masonry only when necessary to halt deterioration or remove heavy soiling.	Cleaning masonry surfaces when they are not heavily soiled to create a new appearance, thus needlessly introducing chemicals or moisture into historic materials.
Carrying out masonry surface cleaning tests after it has been determined that such cleaning is necessary. Tests should be observed over a sufficient period of time so that both the immediate effects and the long range effects are known to enable selection of the gentlest method possible.	Cleaning masonry surfaces without testing or without sufficient time for the testing results to be of value.
Cleaning masonry surfaces with the gentlest method possible, such as low pressure water and detergents, using natural bristle brushes.	Sandblasting brick or stone surfaces using dry or wet grit or other abrasives. These methods of cleaning permanently erode the surface of the material and accelerate deterioration.
	Using a cleaning method that involves water or liquid chemical solutions when there is any possibility of freezing temperatures.
	Cleaning with chemical products that will damage masonry, such as using acid on limestone or marble, or leaving chemicals on masonry surfaces.
	Applying high pressure water cleaning methods that will damage historic masonry and the mortar joints.
Inspecting painted masonry surfaces to determine whether repainting is necessary.	Removing paint that is firmly adhering to, and thus protecting, masonry surfaces.
Removing damaged or deteriorated paint only to the next sound layer using the gentlest method possible (e.g., handscraping) prior to repainting.	Using methods of removing paint which are destructive to masonry, such as sandblasting, application of caustic solutions, or high pressure waterblasting.
Applying compatible paint coating systems following proper surface preparation.	Failing to follow manufacturers' product and application instructions when repainting masonry.
Repainting with colors that are historically appropriate to the building and district.	Using new paint colors that are inappropriate to the historic building and district.

Recommended	Not Recommended
Evaluating the overall condition of the masonry to determine whether more than protection and maintenance are required, that is, if repairs to the masonry features will be necessary.	Failing to undertake adequate measures to assure the preservation of masonry features.
Repairing masonry walls and other masonry features by repointing the mortar joints where there is evidence of deterioration such as disintegrating mortar, cracks in mortar joints, loose bricks, damp walls, or damaged plasterwork.	Removing nondeteriorated mortar from sound joints, then repointing the entire building to achieve a uniform appearance.
Removing deteriorated mortar by carefully hand-raking the joints to avoid damaging the masonry.	Using electric saws and hammers rather than hand tools to remove deteriorated mortar from joints prior to repointing.
Duplicating old mortar in strength, composition, color, and texture.	Repointing with mortar of high portland cement content (unless it is the content of the historic mortar). This can often create a bond that is stronger than the historic material and can cause damage as a result of the differing coefficient of expansion and the differing porosity of the material and the mortar.
	Repointing with a synthetic caulking compound.
	Using a "scrub" coating technique to repoint instead of traditional repointing methods.
Duplicating old mortar joints in width and in joint profile.	Changing the width or joint profile when repointing.
Repairing stucco by removing the damaged material and patching with new stucco that duplicates the old in strength, composition, color, and texture.	Removing sound stucco; or repairing with new stucco that is stronger than the historic material or does not convey the same visual appearance.
Using mud plaster as a surface coating over unfired, unstabilized adobe because the mud plaster will bond to the adobe.	Applying cement stucco to unfired, unstabilized adobe. Because the cement stucco will not bond properly, moisture can become entrapped between materials, resulting in accelerated deterioration of the adobe.

Recommended	Not Recommended
Repairing masonry features by patching, piecing-in, or consolidating the masonry using recognized preservation methods. Repair may also include the limited replacement in kind--or with compatible substitute material--of those extensively deteriorated or missing parts of masonry features when there are surviving prototypes such as terra-cotta brackets or stone balusters.	Replacing an entire masonry feature such as a cornice or balustrade when repair of the masonry and limited replacement of deteriorated or missing parts are appropriate. Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the masonry feature or that is physically or chemically incompatible.
Applying new or non-historic surface treatments such as water-repellent coatings to masonry only after repointing and only if masonry repairs have failed to arrest water penetration problems.	Applying waterproof, water-repellent, or non-historic coatings such as stucco to masonry as a substitute for repointing and masonry repairs. Coatings are frequently unnecessary, expensive, and may change the appearance of historic masonry as well as accelerate its deterioration.
Replacing in kind an entire masonry feature that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence to guide the new work. Examples can include large sections of a wall, a cornice, balustrade, column, or stairway. If using the same kind of material is not technically or economically feasible, then a compatible subsitute material may be considered.	Removing a masonry feature that is unrepairable and not replacing it; or replacing it with a new feature that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and installing a new masonry feature such as steps or a door pediment when the historic feature is completely missing. It may be an accurate restoration using historical, pictorial, and physical documentation; or be a new design that is compatible with the size, scale, material, and color of the historic building.	Creating a false historical appearance because the replaced masonry feature is based on insufficient historical, pictorial, and physical documentation. Introducing a new masonry feature that is incompatible in size, scale, material and color.

Wood: Clapboard, weatherboard, shingles, and other wooden siding and decorative elements

Because it can be easily shaped by sawing, planing, carving, and gouging, wood is the most commonly used material for architectural features such as clapboards, cornices, brackets, entablatures, shutters, columns and balustrades. These wooden features--both functional and decorative--may be important in defining the historic character of the building and thus their retention, protection, and repair are of particular importance in rehabilitation projects. For specific guidance, consult Preservation Briefs: 9, 10, and "Epoxies for Wood Repair in Historic Buildings." (See Reading List and Ordering Information on pg. 58.)

Recommended	Not Recommended
Identifying, retaining, and preserving wood features that are important in defining the overall historic character of the building such as siding, cornices, brackets, window architraves, and doorway pediments; and their paints, finishes, and colors.	Removing or radically changing wood features which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Removing a major portion of the historic wood from a facade instead of repairing or replacing only the deteriorated wood, then reconstructing the facade with new material in order to achieve a uniform or "improved" appearance. Radically changing the type of finish or its color or accent scheme so that the historic charcter of the exterior is diminished. Stripping historically painted surfaces to bare wood, then applying clear finishes or stains in order to create a "natural look." Stripping paint or varnish to bare wood rather than repairing or reapplying a special finish, i.e., a grained finish to an exterior wood feature such as a front door.
Protecting and maintaining wood features by providing proper drainage so that water is not allowed to stand on flat, horizontal surfaces or accumulate in decorative features.	Failing to identify, evaluate, and treat the causes of wood deterioration, including faulty flashing, leaking gutters, cracks and holes in siding, deteriorated caulking in joints and seams, plant material growing too close to wood surfaces, or insect or fungus infestation.

Recommended	Not Recommended
Applying chemical preservatives to wood features such as beam ends or outriggers that are exposed to decay hazards and are traditionally unpainted.	Using chemical preservatives such as creosote which can change the appearance of wood features unless they were used historically.
Retaining coatings such as paint that help protect the wood from moisture and ultraviolet light. Paint removal should be considered only where there is paint surface deterioration and as part of an overall maintenance program which involves repainting or applying other appropriate protective coatings.	Stripping paint or other coatings to reveal bare wood, thus exposing historically coated surfaces to the effects of accelerated weathering.
Inspecting painted wood surfaces to determine whether repainting is necessary or if cleaning is all that is required.	Removing paint that is firmly adhering to, and thus, protecting wood surfaces.
Removing damaged or deteriorated paint to the next sound layer using the gentlest method possible (handscraping and handsanding), then repainting.	Using destructive paint removal methods such as a propane or butane torches, sandblasting or waterblasting. These methods can irreversibly damage historic woodwork.
Using with care electric hot-air guns on decorative wood features and electric heat plates on flat wood surfaces when paint is so deteriorated that total removal is necessary prior to repainting.	Using thermal devices improperly so that the historic woodwork is scorched.
Using chemical strippers primarily to supplement other methods such as handscraping, handsanding and the above-recommended thermal devices. Detachable wooden elements such as shutters, doors, and columns may--with the proper safeguards--be chemically dip-stripped.	Failing to neutralize the wood thoroughly after using chemicals so that new paint does not adhere. Allowing detachable wood features to soak too long in a caustic solution so that the wood grain is raised and the surface roughened.
Applying compatible paint coating systems following proper surface preparation.	Failing to follow manufacturers' product and application instructions when repainting exterior woodwork.
Repainting with colors that are appropriate to the historic building and district.	Using new colors that are inappropriate to the historic building or district.
Evaluating the overall condition of the wood to determine whether more than protection and maintenance are required, that is, if repairs to wood features will be necessary.	Failing to undertake adequate measures to assure the preservation of wood features.

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Recommended	Not Recommended
Repairing wood features by patching, piecing-in, consolidating, or otherwise reinforcing the wood using recognized preservation methods. Repair may also include the limited replacement in kind--or with compatible substitute material--of those extensively deteriorated or missing parts of features where there are surviving prototypes such as brackets, moldings, or sections of siding.	Replacing an entire wood feature such as a cornice or wall when repair of the wood and limited replacement of deteriorated or missing parts are appropriate. Using substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the wood feature or that is physically or chemically incompatible.
Replacing in kind an entire wood feature, that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence to guide the new work. Examples of wood features include a cornice, entablature or balustrade. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.	Removing an entire wood feature that is unrepairable and not replacing it; or replacing it with a new feature that does not convey the same visual appearance.

The following work is highlighted because it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and installing a new wood feature such as a cornice or doorway when the historic feature is completely missing. It may be an accurate restoration using historical, pictorial, and physical documentation; or be a new design that is compatible with the size, scale, material, and color of the historic building.	Creating a false historic appearance because the replaced wood feature is based on insufficient historical, pictorial, and physical documentation. Introducing a new wood feature that is incompatible in size, scale, material, and color.

Architectural Metals: Cast iron, steel, pressed tin, copper, aluminum, and zinc

Architectural metal features--such as cast-iron facades, porches, and steps; sheet metal cornices, roofs, roof cresting and storefronts; and cast or rolled metal doors, window sash, entablatures, and hardware--are often highly decorative and may be important in defining the overall historic character of the building. Their retention, protection, and repair should be a prime consideration in rehabilitation projects. For specific guidance, consult "Metals in America's Historic Buildings." (See Reading List and Ordering Information on pg. 58.)

Recommended	Not Recommended
Identifying, retaining, and preserving architectural metal features such as columns, capitals, window hoods, or stairways that are important in defining the overall historic character of the building; and their finishes and colors.	Removing or radically changing architectural metal features which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Removing a major portion of the historic architectural metal from a facade instead of repairing or replacing only the deteriorated metal, then reconstructing the facade with new material in order to create a uniform, or "improved" appearance. Radically changing the type of finish or its historic color or accent scheme.
Protecting and maintaining architectural metals from corrosion by providing proper drainage so that water does not stand on flat, horizontal surfaces or accumulate in curved, decorative features.	Failing to identify, evaluate, and treat the causes of corrosion, such as moisture from leaking roofs or gutters. Placing incompatible metals together without providing a reliable separation material. Such incompatibility can result in galvanic corrosion of the less noble metal, e.g., copper will corrode cast iron, steel, tin, and aluminum.
Cleaning architectural metals, when necessary, to remove corrosion prior to repainting or applying other appropriate protective coatings.	Exposing metals which were intended to be protected from the environment. Applying paint or other coatings to metals such as copper, bronze, or stainless steel that were meant to be exposed.

Recommended	Not Recommended
Identifying the particular type of metal prior to any cleaning procedure and then testing to assure that the gentlest cleaning method possible is selected or determining that cleaning is inappropriate for the particular metal.	Using cleaning methods which alter or damage the historic color, texture, and finish of the metal; or cleaning when it is inappropriate for the metal.
	Removing the patina of historic metal. The patina may be a protective coating on some metals, such as bronze or copper, as well as a significant historic finish.
Cleaning soft metals such as lead, tin, copper, terneplate, and zinc with appropriate chemical methods because their finishes can be easily abraded by blasting methods.	Cleaning soft metals such as lead, tin, copper, terneplate, and zinc with grit blasting which will abrade the surface of the metal.
Using the gentlest cleaning methods for cast iron, wrought iron, and steel--hard metals--in order to remove paint buildup and corrosion. If handscraping and wire brushing have proven ineffective, low pressure dry grit blasting may be used as long as it does not abrade or damage the surface.	Failing to employ gentler methods prior to abrasively cleaning cast iron, wrought iron or steel; or using high pressure grit blasting.
Applying appropriate paint or other coating systems after cleaning in order to decrease the corrosion rate of metals or alloys.	Failing to re-apply protective coating systems to metals or alloys that require them after cleaning so that accelerated corrosion occurs.
Repainting with colors that are appropriate to the historic building or district.	Using new colors that are inappropriate to the historic building or district.
Applying an appropriate protective coating such as lacquer to an architectural metal feature such as a bronze door which is subject to heavy pedestrian use.	Failing to assess pedestrian use or new access patterns so that architectural metal features are subject to damage by use or inappropriate maintenance such as salting adjacent sidewalks.
Evaluating the overall condition of the architectural metals to determine whether more than protection and maintenance are required, that is, if repairs to features will be necessary.	Failing to undertake adequate measures to assure the preservation of architectural metal features.

Recommended	Not Recommended
Repairing architectural metal features by patching, splicing, or otherwise reinforcing the metal following recognized preservation methods. Repairs may also include the limited replacement in kind--or with a compatible substitute material--of those extensively deteriorated or missing parts of features when there are surviving prototypes such as porch balusters, column capitals or bases; or porch cresting.	Replacing an entire architectural metal feature such as a column or a balustrade when repair of the metal and limited replacement of deteriorated or missing parts are appropriate. Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the architectural metal feature or is that physically or chemically incompatible.
Replacing in kind an entire architectural metal feature that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence to guide the new work. Examples could include cast iron porch steps or steel sash windows. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.	Removing an architectural metal feature that is unrepairable and not replacing it; or replacing it with a new architectural metal feature that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and installing a new architectural metal feature such as a sheet metal cornice or cast iron capital when the historic feature is completely missing. It may be an accurate restoration using historical, pictorial, and physical documentation; or be a new design that is compatible with the size, scale, material, and color of the historic building.	Creating a false historic appearance because the replaced architectural metal feature is based on insufficient historical, pictorial, and physical documentation. Introducing a new architectural metal feature that is incompatible in size, scale, material, and color.

Roofs

The roof--with its shape; features such as cresting, dormers, cupolas, and chimneys; and the size, color, and patterning of the roofing material--can be extremely important in defining the building's overall historic character. In addition to the design role it plays, a weathertight roof is essential to the preservation of the entire structure; thus, protecting and repairing the roof as a "cover" is a critical aspect of every rehabilitation project. For specific guidance on roofs and roofing material, consult Preservation Briefs: 4. (See Reading List and Ordering Information on pg. 58.)

Recommended	Not Recommended
Identifying, retaining, and preserving roofs--and their functional and decorative features--that are important in defining the overall historic character of the building. This includes the roof's shape, such as hipped, gambrel, and mansard; decorative features such as cupolas, cresting, chimneys, and weathervanes; and roofing material such as slate, wood, clay tile, and metal, as well as its size, color, and patterning.	Radically changing, damaging, or destroying roofs which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Removing a major portion of the roof or roofing material that is repairable, then reconstructing it with new material in order to create a uniform, or "improved" appearance. Changing the configuration of a roof by adding new features such as dormer windows, vents, or skylights so that the historic character is diminished. Stripping the roof of sound historic material such as slate, clay tile, wood, and architectural metal. Applying paint or other coatings to roofing material which has been historically uncoated.
Protecting and maintaining a roof by cleaning the gutters and downspouts and replacing deteriorated flashing. Roof sheathing should also be checked for proper venting to prevent moisture condensation and water penetration; and to insure that materials are free from insect infestation.	Failing to clean and maintain gutters and downspouts properly so that water and debris collect and cause damage to roof fasteners, sheathing, and the underlying structure.
Providing adequate anchorage for roofing material to guard against wind damage and moisture penetration.	Allowing roof fasteners, such as nails and clips to corrode so that roofing material is subject to accelerated deterioration.

Recommended	Not Recommended
Protecting a leaking roof with plywood and building paper until it can be properly repaired.	Permitting a leaking roof to remain unprotected so that accelerated deterioration of historic building materials--masonry, wood, plaster, paint and structural members--occurs.
Repairing a roof by reinforcing the historic materials which comprise roof features. Repairs will also generally include the limited replacement in kind--or with compatible substitute material--of those extensively deteriorated or missing parts of features when there are surviving prototypes such as cupola louvers, dentils, dormer roofing; or slates, tiles, or wood shingles on a main roof.	Replacing an entire roof feature such as a cupola or dormer when repair of the historic materials and limited replacement of deteriorated or missing parts are appropriate. Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the roof or that is physically or chemically incompatible.
Replacing in kind an entire feature of the roof that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence to guide the new work. Examples can include a large section of roofing, or a dormer or chimney. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.	Removing a feature of the roof that is unrepairable, such as a chimney or dormer, and not replacing it; or replacing it with a new feature that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and constructing a new feature when the historic feature is completely missing, such as a chimney or cupola. It may be an accurate restoration using historical, pictorial and physical documentation; or be a new design that is compatible with the size, scale, material, and color of the historic building.	Creating a false historical appearance because the replaced feature is based on insufficient historical, pictorial, and physical documentation. Introducing a new roof feature that is incompatible in size, scale, material, and color.

Roof (continued)

Recommended	Not Recommended
Alterations/Additions for the New Use	
Installing mechanical and service equipment on the roof such as air conditioning, transformers, or solar collectors when required for the new use so that they are inconspiuous from the public right-of-way and do not damage or obscure character-defining features.	Installing mechanical or service equipment so that it damages or obscures character-defining features; or is conspicuous from the public right-of-way.
Designing additions to roofs such as residential, office, or storage spaces; elevator housing; decks and terraces; or dormers or skylights when required by the new use so that they are inconspicuous from the public right-of-way and do not damage or obscure character-defining features.	Radically changing a character-defining roof shape or damaging or destroying character-defining roofing material as a result of incompatible design or improper installation techniques.

Windows

A highly decorative window with an unusual shape, or glazing pattern, or color is most likely identified immediately as a character-defining feature of the building. It is far more difficult, however, to assess the importance of repeated windows on a facade, particularly if they are individually simple in design and material, such as the large, multi-paned sash of many industrial buildings. Because rehabilitation projects frequently include proposals to replace window sash or even entire windows to improve thermal efficiency or to create a new appearance, it is essential that their contribution to the overall historic character of the building be assessed together with their physical condition before specific repair or replacement work is undertaken. See also Energy Retrofitting. Preservation Briefs: 9 should be consulted for specific guidance on wooden window repair. (See Reading List and Ordering Information on pg. 58.)

Recommended	Not Recommended
Identifying, retaining, and preserving windows--and their functional and decorative features--that are important in defining the overall historic character of the building. Such features can include frames, sash, muntins, glazing, sills, heads, hoodmolds, panelled or decorated jambs and moldings, and interior and exterior shutters and blinds.	Removing or radically changing windows which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Changing the number, location, size or glazing pattern of windows, through cutting new openings, blocking-in windows, and installing replacement sash which does not fit the historic window opening. Changing the historic appearance of windows through the use of inappropriate designs, materials, finishes, or colors which radically change the sash, depth of reveal, and muntin configuration; the reflectivity and color of the glazing; or the appearance of the frame. Obscuring historic window trim with metal or other material. Stripping windows of historic material such as wood, iron, cast iron, and bronze.
Protecting and maintaining the wood and architectural metal which comprise the window frame, sash, muntins, and surrounds through appropriate surface treatments such as cleaning, rust removal, limited paint removal, and re-application of protective coating systems.	Failing to provide adequate protection of materials on a cyclical basis so that deterioration of the windows results.

Recommended	Not Recommended
Making windows weathertight by recaulking and replacing or installing weatherstripping. These actions also improve thermal efficiency.	Retrofitting or replacing windows rather than maintaining the sash, frame, and glazing.
Evaluating the overall condition of materials to determine whether more than protection and maintenance are required, i.e. if repairs to windows and window features will be required.	Failing to undertake adequate measures to assure the preservation of historic windows.
Repairing window frames and sash by patching, splicing, consolidating or otherwise reinforcing. Such repair may also include replacement in kind of those parts that are either extensively deteriorated or are missing when there are surviving prototypes such as architraves, hoodmolds, sash, sills, and interior or exterior shutters and blinds.	Replacing an entire window when repair of materials and limited replacement of deteriorated or missing parts are appropriate. Failing to reuse serviceable window hardware such as brass lifts and sash locks. Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the window or that is physically or chemically incompatible.
Replacing in kind an entire window that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence to guide the new work. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.	Removing a character-defining window that is unrepairable and blocking it in; or replacing it with a new window that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and installing new windows when the historic windows (frame, sash and glazing) are completely missing. The replacement windows may be an accurate restoration using historical, pictorial, and physical documentation; or be a new design that is compatible with the window openings and the historic character of the building.	Creating a false historical appearance because the replaced window is based on insufficient historical, pictorial, and physical documentation. Introducing a new design that is incompatible with the historic character of the building.

Recommended	Not Recommended
Alterations/Additions for the New Use	
Designing and installing additional windows on rear or other-non character-defining elevations if required by the new use. New window openings may also be cut into exposed party walls. Such design should be compatible with the overall design of the building, but not duplicate the fenestration pattern and detailing of a character-defining elevation.	Installing new windows, including frames, sash, and muntin configuration that are incompatible with the building's historic appearance or obscure, damage, or destroy character-defining features.
Providing a setback in the design of dropped ceilings when they are required for the new use to allow for the full height of the window openings.	Inserting new floors or furred-down ceilings which cut across the glazed areas of windows so that the exterior form and appearance of the windows are changed.

Entrances and Porches

Entrances and porches are quite often the focus of historic buildings, particularly when they occur on primary elevations. Together with their functional and decorative features such as doors, steps, balustrades, pilasters, and entablatures, they can be extremely important in defining the overall historic character of a building. Their retention, protection, and repair should always be carefully considered when planning rehabilitation work.

Recommended	Not Recommended
Identifying, retaining, and preserving entrances--and their functional and decorative features--that are important in defining the overall historic character of the building such as doors, fanlights, sidelights, pilasters, entablatures, columns, balustrades, and stairs.	Removing or radically changing entrances and porches which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Stripping entrances and porches of historic material such as wood, iron, cast iron, terra cotta, tile and brick. Removing an entrance or porch because the building has been re-oriented to accommodate a new use. Cutting new entrances on a primary elevation. Altering utilitarian or service entrances so they appear to be formal entrances by adding panelled doors, fanlights, and sidelights.
Protecting and maintaining the masonry, wood, and architectural metal that comprise entrances and porches through appropriate surface treatments such as cleaning, rust removal, limited paint removal, and re-application of protective coating systems.	Failing to provide adequate protection to materials on a cyclical basis so that deterioration of entrances and porches results.
Evaluating the overall condition of materials to determine whether more than protection and maintenance are required, that is, if repairs to entrance and porch features will be necessary.	Failing to undertake adequate measures to assure the preservation of historic entrances and porches.

Recommended	Not Recommended
Repairing entrances and porches by reinforcing the historic materials. Repair will also generally include the limited replacement in kind--or with compatible substitute material--of those extensively deteriorated or missing parts of repeated features where there are surviving prototypes such as balustrades, cornices, entablatures, columns, sidelights, and stairs.	Replacing an entire entrance or porch when the repair of materials and limited replacement of parts are appropriate. Using a substitute material for the replacement parts that does not convey the visual appearance of the surviving parts of the entrance and porch or that is physically or chemically incompatible.
Replacing in kind an entire entrance or porch that is too deteriorated to repair--if the form and detailing are still evident--using the physical evidence to guide the new work. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.	Removing an entrance or porch that is unrepairable and not replacing it; or replacing it with a new entrance or porch that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and constructing a new entrance or porch if the historic entrance or porch is completely missing. It may be a restoration based on historical, pictorial, and physical documentation; or be a new design that is compatible with the historic character of the building.	Creating a false historical appearance because the replaced entrance or porch is based on insufficient historical, pictorial, and physical documentation. Introducing a new entrance or porch that is incompatible in size, scale, material, and color.

Alterations/Additions for the New Use

Recommended	Not Recommended
Designing enclosures for historic porches when required by the new use in a manner that preserves the historic character of the building. This can include using large sheets of glass and recessing the enclosure wall behind existing scrollwork, posts, and balustrades.	Enclosing porches in a manner that results in a diminution or loss of historic character such as using solid materials such as wood, stucco, or masonry.

Recommended	Not Recommended
Designing and installing additional entrances or porches when required for the new use in a manner that preserves the historic character of the building, i.e., limiting such alteration to non-character-defining elevations.	Installing secondary service entrances and porches that are incompatible in size and scale with the historic building or obscure, damage, or destroy character-defining features.

Storefronts

Storefronts are quite often the focus of historic commercial buildings and can thus be extremely important in defining the overall historic character. Because storefronts also play a crucial role in a store's advertising and merchandising strategy to draw customers and increase business, they are often altered to meet the needs of a new business. Particular care is required in planning and accomplishing work on storefronts so that the building's historic character is preserved in the process of rehabilitation. For specific guidance on the subject Preservation Briefs: 11 should be consulted. (See Reading List and Ordering Information on pg. 58.)

Recommended	Not Recommended
Identifying, retaining, and preserving storefronts--and their functional and decorative features--that are important in defining the overall historic character of the building such as display windows, signs, doors, transoms, kick plates, corner posts, and entablatures.	Removing or radically changing storefronts--and their features--which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Changing the storefront so that it appears residential rather than commercial in character. Removing historic material from the storefront to create a recessed arcade. Introducing coach lanterns, mansard overhangings, wood shakes, nonoperable shutters, and small-paned windows if they cannot be documented historically. Changing the location of a storefront's main entrance.
Protecting and maintaining masonry, wood, and architectural metals which comprise storefronts through appropriate treatments such as cleaning, rust removal, limited paint removal, and reapplication of protective coating systems.	Failing to provide adequate protection to materials on a cyclical basis so that deterioration of storefront features results.
Protecting storefronts against arson and vandalism before work begins by boarding up windows and installing alarm systems that are keyed into local protection agencies.	Permitting entry into the building through unsecured or broken windows and doors so that interior features and finishes are damaged through exposure to weather or through vandalism. Stripping storefronts of historic material such as wood, cast iron, terra cotta, carrara glass, and brick.

Recommended	Not Recommended
Evaluating the overall condition of storefront materials to determine whether more than protection and maintenance are required, that is, if repairs to features will be necessary.	Failing to undertake adequate measures to assure the preservation of the historic storefront.
Repairing storefronts by reinforcing the historic materials. Repairs will also generally include the limited replacement in kind--or with compatible substitute material--of those extensively deteriorated or missing parts of storefronts where there are surviving prototypes such as transoms, kick plates, pilasters, or signs.	Replacing an entire storefront when repair of materials and limited replacement of its parts are appropriate. Using substitute material for the replacement parts that does not convey the same visual appearance as the surviving parts of the storefront or that is physically or chemically incompatible.
Replacing in kind an entire storefront that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence to guide the new work. If using the same material is not technically or economically feasible, then compatible substitute materials may be considered.	Removing a storefront that is unrepairable and not replacing it; or replacing it with a new storefront that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and constructing a new storefront when the historic storefront is completely missing. It may be an accurate restoration using historical, pictorial, and physical documentation; or be a new design that is compatible with the size, scale, material, and color of the historic building. Such new design should generally be flush with the facade; and the treatment of secondary design elements, such as awnings or signs, kept as simple as possible. For example, new signs should fit flush with the existing features of the facade, such as the fascia board or cornice.	Creating a false historical appearance because the replaced storefront is based on insufficient historical, pictorial, and physical documentation. Introducing a new design that is incompatible in size, scale, material, and color. Using new illuminated signs; inappropriately scaled signs and logos; signs that project over the sidewalk unless they were a characteristic feature of the historic building; or other types of signs that obscure, damage, or destroy remaining character-defining features of the historic building.

BUILDING INTERIOR

Structural System

If features of the structural system are exposed such as loadbearing brick walls, cast iron columns, roof trusses, posts and beams, vigas, or stone foundation walls, they may be important in defining the building's overall historic character. Unexposed structural features that are not character-defining or an entire structural system may nonetheless be significant in the history of building technology; therefore, the structural system should always be examined and evaluated early in the project planning stage to determine both its physical condition and its importance to the building's historic character or historical significance. See also Health and Safety Code Requirements.

Recommended

Identifying, retaining, and preserving structural systems--and individual features of systems--that are important in defining the overall historic character of the building, such as post and beam systems, trusses, summer beams, vigas, cast iron columns, above-grade stone foundation walls, or loadbearing brick or stone walls.

Not Recommended

Removing, covering, or radically changing features of structural systems which are important in defining the overall historic character of the building so that, as a result, the character is diminished.

Putting a new use into the building which could overload the existing structural system; or installing equipment or mechanical systems which could damage the structure.

Demolishing a loadbearing masonry wall that could be augmented and retained and replacing it with a new wall (i.e., brick or stone), using the historic masonry only as an exterior veneer.

Leaving known structural problems untreated such as deflection of beams, cracking and bowing of walls, or racking of structural members.

Utilizing treatments or products that accelerate the deterioration of structural material such as introducing urea-formaldehyde foam insulation into frame walls.

Recommended	Not Recommended
Protecting and maintaining the structural system by cleaning the roof gutters and downspouts; replacing roof flashing; keeping masonry, wood, and architectural metals in a sound condition; and assuring that structural members are free from insect infestation.	Failing to provide proper building maintenance on a cyclical basis so that deterioration of the structural system results.
Examining and evaluating the physical condition of the structural system and its individual features using non-destructive techniques such as X-ray photography.	Utilizing destructive probing techniques that will damage or destroy structural material.
Repairing the structural system by augmenting or upgrading individual parts or features. For example, weakened structural members such as floor framing can be spliced, braced, or otherwise supplemented and reinforced.	Upgrading the building structurally in a manner that diminishes the historic character of the exterior, such as installing strapping channels or removing a decorative cornice; or damages interior features or spaces. Replacing a structural member or other feature of the structural system when it could be augmented and retained.
Replacing in kind--or with substitute material--those portions or features of the structural system that are either extensively deteriorated or are missing when there are surviving prototypes such as cast iron columns, roof rafters or trusses, or sections of loadbearing walls. Substitute material should convey the same form, design, and overall visual appearance as the historic feature; and, at a minimum, be equal to its loadbearing capabilities.	Installing a replacement feature that does not convey the same visual appearance, e.g., replacing an exposed wood summer beam with a steel beam. Using substitute material that does not equal the loadbearing capabilities of the historic material and design or is otherwise physically or chemically incompatible.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Alterations/Additions for the New Use

Recommended	Not Recommended
Limiting any new excavations adjacent to historic foundations to avoid undermining the structural stability of the building or adjacent historic buildings.	Carrying out excavations or regrading adjacent to or within a historic building which could cause the historic foundation to settle, shift, or fail; or could have a similar effect on adjacent historic buildings.

Recommended	Not Recommended
Correcting structural deficiencies in preparation for the new use in a manner that preserves the structural system and individual character-defining features.	Radically changing interior spaces or damaging or destroying features or finishes that are character-defining while trying to correct structural deficiencies in preparation for the new use.
Designing and installing new mechanical or electrical systems when required for the new use which minimize the number of cutouts or holes in structural members.	Installing new mechanical and electrical systems or equipment in a manner which results in numerous cuts, splices, or alterations to the structural members.
Adding a new floor when required for the new use if such an alteration does not damage or destroy the structural system or obscure, damage, or destroy character-defining spaces, features, or finishes.	Inserting a new floor when such a radical change damages a structural system or obscures or destroys interior spaces, features, or finishes. Inserting new floors or furred-down ceilings which cut across the glazed areas of windows so that the exterior form and appearance of the windows are radically changed.
Creating an atrium or a light well to provide natural light when required for the new use in a manner that assures the preservation of the structural system as well as character-defining interior spaces, features, and finishes.	Damaging the structural system or individual features; or radically changing, damaging, or destroying character-defining interior spaces, features, or finishes in order to create an atrium or a light well.

Interior: Spaces, Features, and Finishes

An interior floor plan, the arrangement of spaces, and built-in features and applied finishes may be individually or collectively important in defining the historic character of the building. Thus, their identification, retention, protection, and repair should be given prime consideration in every rehabilitation project and caution exercised in pursuing any plan that would radically change character-defining spaces or obscure, damage or destroy interior features or finishes.

Recommended	Not Recommended
Interior Spaces	
Identifying, retaining, and preserving a floor plan or interior spaces that are important in defining the overall historic character of the building. This includes the size, configuration, proportion, and relationship of rooms and corridors; the relationship of features to spaces; and the spaces themselves such as lobbies, reception halls, entrance halls, double parlors, theaters, auditoriums, and important industrial or commercial use spaces.	Radically changing a floor plan or interior spaces--including individual rooms--which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Altering the floor plan by demolishing principal walls and partitions to create a new appearance. Altering or destroying interior spaces by inserting floors, cutting through floors, lowering ceilings, or adding or removing walls. Relocating an interior feature such as a staircase so that the historic relationship between features and spaces is altered.

Recommended	Not Recommended

Interior Features and Finishes

Identifying, retaining, and preserving interior features and finishes that are important in defining the overall historic character of the building, including columns, cornices, baseboards, fireplaces and mantels, paneling, light fixtures, hardware, and flooring; and wallpaper, plaster, paint, and finishes such as stenciling, marbling, and graining; and other decorative materials that accent interior features and provide color, texture, and patterning to walls, floors, and ceilings.

Removing or radically changing features and finishes which are important in defining the overall historic character of the building so that, as a result, the character is diminished.

Installing new decorative material that obscures or damages character-defining interior features or finishes.

Removing paint, plaster, or other finishes from historically finished surfaces to create a new appearance (e.g., removing plaster to expose masonry surfaces such as brick walls or a chimney piece).

Applying paint, plaster, or other finishes to surfaces that have been historically unfinished to create a new appearance.

Stripping historically painted wood surfaces to bare wood, then applying clear finishes or stains to create a "natural look."

Stripping paint to bare wood rather than repairing or reapplying grained or marbled finishes to features such as doors and paneling.

Radically changing the type of finish or its color, such as painting a previously varnished wood feature.

Protecting and maintaining masonry, wood, and architectural metals which comprise interior features through appropriate surface treatments such as cleaning, rust removal, limited paint removal, and reapplication of protective coatings systems.

Failing to provide adequate protection to materials on a cyclical basis so that deterioration of interior features results.

Recommended	Not Recommended
Protecting interior features and finishes against arson and vandalism before project work begins, erecting protective fencing, boarding-up windows, and installing fire alarm systems that are keyed to local protection agencies.	Permitting entry into historic buildings through unsecured or broken windows and doors so that interior features and finishes are damaged by exposure to weather or through vandalism. Stripping interiors of features such as woodwork, doors, windows, light fixtures, copper piping, radiators; or of decorative materials.
Protecting interior features such as a staircase, mantel, or decorative finishes and wall coverings against damage during project work by covering them with heavy canvas or plastic sheets.	Failing to provide proper protection of interior features and finishes during work so that they are gouged, scratched, dented, or otherwise damaged.
Installing protective coverings in areas of heavy pedestrian traffic to protect historic features such as wall coverings, parquet flooring and panelling.	Failing to take new use patterns into consideration so that interior features and finishes are damaged.
Removing damaged or deteriorated paints and finishes to the next sound layer using the gentlest method possible, then repainting or refinishing using compatible paint or other coating systems.	Using destructive methods such as propane or butane torches or sandblasting to remove paint or other coatings. These methods can irreversibly damage the historic materials that comprise interior features.
Repainting with colors that are appropriate to the historic building.	Using new paint colors that are inappropriate to the historic building.
Limiting abrasive cleaning methods to certain industrial or warehouse buildings where the interior masonry or plaster features do not have distinguishing design, detailing, tooling, or finishes; and where wood features are not finished, molded, beaded, or worked by hand. Abrasive cleaning should only be considered after other, gentler methods have been proven ineffective.	Changing the texture and patina of character-defining features through sandblasting or use of other abrasive methods to remove paint, discoloration or plaster. This includes both exposed wood (including structural members) and masonry.
Evaluating the overall condition of materials to determine whether more than protection and maintenance are required, that is, if repairs to interior features and finishes will be necessary.	Failing to undertake adequate measures to assure the preservation of interior features and finishes.

Recommended | Not Recommended

Repairing interior features and finishes by reinforcing the historic materials. Repair will also generally include the limited replacement in kind--or with compatible substitute material--of those extensively deteriorated or missing parts of repeated features when there are surviving prototypes such as stairs, balustrades, wood panelling, columns; or decorative wall coverings or ornamental tin or plaster ceilings.

Replacing an entire interior feature such as a staircase, panelled wall, parquet floor, or cornice; or finish such as a decorative wall covering or ceiling when repair of materials and limited replacement of such parts are appropriate.

Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts or portions of the interior feature or finish or that is physically or chemically incompatible.

Replacing in kind an entire interior feature or finish that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence to guide the new work. Examples could include wainscoting, a tin ceiling, or interior stairs. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.

Removing a character-defining feature or finish that is unrepairable and not replacing it; or replacing it with a new feature or finish that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Designing and installing a new interior feature or finish if the historic feature or finish is completely missing. This could include missing partitions, stairs, elevators, lighting fixtures, and wall coverings; or even entire rooms if all historic spaces, features, and finishes are missing or have been destroyed by inappropriate "renovations." The design may be a restoration based on historical, pictorial, and physical documentation; or be a new design that is compatible with the historic character of the building, district, or neighborhood.

Creating a false historical appearance because the replaced feature is based on insufficient physical, historical, and pictorial documentation or on information derived from another building.

Introducing a new interior feature or finish that is incompatible with the scale, design, materials, color, and texture of the surviving interior features and finishes.

Recommended	Not Recommended
Alterations/Additions for the New Use	
Accommodating service functions such as bathrooms, mechanical equipment, and office machines required by the building's new use in secondary spaces such as first floor service areas or on upper floors.	Dividing rooms, lowering ceilings, and damaging or obscuring character-defining features such as fireplaces, niches, stairways or alcoves, so that a new use can be accommodated in the building.
Reusing decorative material or features that have had to be removed during the rehabilitation work including wall and baseboard trim, door moulding, panelled doors, and simple wainscoting; and relocating such material or features in areas appropriate to their historic placement.	Discarding historic material when it can be reused within the rehabilitation project or relocating it in historically inappropriate areas.
Installing permanent partitions in secondary spaces; removable partitions that do not destroy the sense of space should be installed when the new use requires the subdivision of character-defining interior spaces.	Installing permanent partitions that damage or obscure character-defining spaces, features, or finishes.
Enclosing an interior stairway where required by code so that its character is retained. In many cases, glazed fire-rated walls may be used.	Enclosing an interior stairway with fire-rated construction so that the stairwell space or any character-defining features are destroyed.
Placing new code-required stairways or elevators in secondary and service areas of the historic building.	Radically changing, damaging, or destroying character-defining spaces, features, or finishes when adding new code-required stairways and elevators.
Creating an atrium or a light well to provide natural light when required for the new use in a manner that preserves character-defining interior spaces, features, and finishes as well as the structural system.	Destroying character-defining interior spaces, features, or finishes; or damaging the structural system in order to create an atrium or light well.
Adding a new floor if required for the new use in a manner that preserves character-defining structural features, and interior spaces, features, and finishes.	Inserting a new floor within a building that alters or destroys the fenestration; radically changes a character-defining interior space; or obscures, damages, or destroys decorative detailing.

Mechanical Systems: Heating, Air Conditioning, Electrial, and Plumbing

The visible features of historic heating, lighting, air conditioning and plumbing systems may sometimes help define the overall historic character of the building and should thus be retained and repaired, whenever possible. The systems themselves (the compressors, boilers, generators and their ductwork, wiring and pipes) will generally either need to be upgraded, augmented, or entirely replaced in order to accommodate the new use and to meet code requirements. Less frequently, individual portions of a system or an entire system are significant in the history of building technology; therefore, the identification of character-defining features or historically significant systems should take place together with an evaluation of their physical condition early in project planning.

Recommended	Not Recommended
Identifying, retaining, and preserving visible features of early mechanical systems that are important in defining the overall historic character of the building, such as radiators, vents, fans, grilles, plumbing fixtures, switchplates, and lights.	Removing or radically changing features of mechanical systems that are important in defining the overall historic character of the building so that, as a result, the character is diminished.
Protecting and maintaining mechanical, plumbing, and electrical systems and their features through cyclical cleaning and other appropriate measures.	Failing to provide adequate protection of materials on a cyclical basis so that deterioration of mechanical systems and their visible features results.
Preventing accelerated deterioration of mechanical systems by providing adequate ventilation of attics, crawlspaces, and cellars so that moisture problems are avoided.	Enclosing mechanical systems in areas that are not adequately ventilated so that deterioration of the systems results.
Repairing mechanical systems by augmenting or upgrading system parts, such as installing new pipes and ducts; rewiring; or adding new compressors or boilers.	Replacing a mechanical system or its functional parts when it could be upgraded and retained.

Recommended	Not Recommended
Replacing in kind--or with compatible substitute material--those visible features of mechanical systems that are either extensively deteriorated or are missing when there are surviving prototypes such as ceiling fans, switchplates, radiators, grilles, or plumbing fixtures.	Installing a replacement feature that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Alterations/Additions for the New Use

Recommended	Not Recommended
Installing a completely new mechanical system if required for the new use so that it causes the least alteration possible to the building's floor plan, the exterior elevations, and the least damage to historic building material.	Installing a new mechanical system so that character-defining structural or interior features are radically changed, damaged, or destroyed.
Installing the vertical runs of ducts, pipes, and cables in closets, service rooms, and wall cavities.	Installing vertical runs of ducts, pipes, and cables in places where they will obscure character-defining features.
	Concealing mechanical equipment in walls or ceilings in a manner that requires the removal of historic building material.
	Installing "dropped" acoustical ceilings to hide mechanical equipment when this destroys the proportions of character-defining interior spaces.
Installing air conditioning units if required by the new use in such a manner that the historic materials and features are not damaged or obscured.	Cutting through features such as masonry walls in order to install air conditioning units.
Installing heating/air conditioning units in the window frames in such a manner that the sash and frames are protected. Window installations should be considered only when all other viable heating/cooling systems would result in significant damage to historic materials.	Radically changing the appearance of the historic building or damaging or destroying windows by installing heating/air conditioning units in historic window frames.

BUILDING SITE

The relationship between a historic building or buildings and landscape features within a property's boundaries--or the building site--helps to define the historic character and should be considered an integral part of overall planning for rehabilitation project work.

Recommended	Not Recommended
Identifying, retaining, and preserving buildings and their features as well as features of the site that are important in defining its overall historic character. Site features can include driveways, walkways, lighting, fencing, signs, benches, fountains, wells, terraces, canal systems, plants and trees, berms, and drainage or irrigation ditches; and archeological features that are important in defining the history of the site.	Removing or radically changing buildings and their features or site features which are important in defining the overall historic character of the building site so that, as a result, the character is diminished.
Retaining the historic relationship between buildings, landscape features, and open space.	Removing or relocating historic buildings or landscape features, thus destroying the historic relationship between buildings, landscape features, and open space.
	Removing or relocating historic buildings on a site or in a complex of related historic structures--such as a mill complex or farm--thus diminishing the historic character of the site or complex.
	Moving buildings onto the site, thus creating a false historical appearance.
	Lowering the grade level adjacent to a building to permit development of a formerly below-grade area such as a basement in a manner that would drastically change the historic relationship of the building to its site.
Protecting and maintaining buildings and the site by providing proper drainage to assure that water does not erode foundation walls; drain toward the building; nor erode the historic landscape.	Failing to maintain site drainage so that buildings and site features are damaged or destroyed; or, alternatively, changing the site grading so that water no longer drains properly.

Recommended	Not Recommended
Minimizing disturbance of terrain around buildings or elsewhere on the site, thus reducing the possibility of destroying unknown archeological materials.	Introducing heavy machinery or equipment into areas where their presence may disturb archeological materials.
Surveying areas where major terrain alteration is likely to impact important archeological sites.	Failing to survey the building site prior to the beginning of rehabilitation project work so that, as a result, important archeological material is destroyed.
Protecting, e.g. preserving in place known archeological material whenever possible.	Leaving known archeological material unprotected and subject to vandalism, looting, and destruction by natural elements such as erosion.
Planning and carrying out any necessary investigation using professional archeologists and modern archeological methods when preservation in place is not feasible.	Permitting unqualified project personnel to perform data recovery so that improper methodology results in the loss of important archeological material.
Protecting the building and other features of the site against arson and vandalism before rehabilitation work begins, i.e., erecting protective fencing and installing alarm systems that are keyed into local protection agencies.	Permitting buildings and site features to remain unprotected so that plant materials, fencing, walkways, archeological features, etc. are damaged or destroyed. Stripping features from buildings and the site such as wood siding, iron fencing, masonry balustrades; or removing or destroying landscape features, including plant material.
Providing continued protection of masonry, wood, and architectural metals which comprise building and site features through appropriate surface treatments such as cleaning, rust removal, limited paint removal, and re-application of protective coating systems; and continued protection and maintenance of landscape features, including plant material.	Failing to provide adequate protection of materials on a cyclical basis so that deterioration of building and site features results.
Evaluating the overall condition of materials to determine whether more than protection and maintenance are required, that is, if repairs to building and site features will be necessary.	Failing to undertake adequate measures to assure the preservation of building and site features.

Recommended	Not Recommended
Repairing features of buildings and the site by reinforcing the historic materials. Repair will also generally include replacement in kind--with a compatible substitute material--of those extensively deteriorated or missing parts of features where there are surviving prototypes such as fencing and paving.	Replacing an entire feature of the building or site such as a fence, walkway, or driveway when repair of materials and limited replacement of deteriorated or missing parts are appropriate. Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the building or site feature or that is physically or chemically incompatible.
Replacing in kind an entire feature of the building or site that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence to guide the new work. This could include an entrance or porch, walkway, or fountain. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.	Removing a feature of the building or site that is unrepairable and not replacing it; or replacing it with a new feature that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation project work and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and constructing a new feature of a building or site when the historic feature is completely missing, such as an outbuilding, terrace, or driveway. It may be based on historical, pictorial, and physical documentation; or be a new design that is compatible with the historic character of the building and site.	Creating a false historical appearance because the replaced feature is based on insufficient historical, pictorial, and physical documentation. Introducing a new building or site feature that is out of scale or otherwise inappropriate. Introducing a new landscape feature or plant material that is visually incompatible with the site or that destroys site patterns or vistas.

Recommended	Not Recommended
Alterations/Additions for the New Use	
Designing new onsite parking, loading docks, or ramps when required by the new use so that they are as unobtrusive as possible and assure the preservation of character-defining features of the site.	Placing parking facilities directly adjacent to historic buildings where automobiles may cause damage to the buildings or landscape features or be intrusive to the building site.
Designing new exterior additions to historic buildings or adjacent new construction which is compatible with the historic character of the site and which preserve the historic relationship between a building or buildings, landscape features, and open space.	Introducing new construction onto the building site which is visually incompatible in terms of size, scale, design, materials, color and texture or which destroys historic relationships on the site.
Removing nonsignificant buildings, additions, or site features which detract from the historic character of the site.	Removing a historic building in a complex, a building feature, or a site feature which is important in defining the historic character of the site.

DISTRICT/NEIGHBORHOOD

The relationship between historic buildings, and streetscape and landscape features within a historic district or neighborhood helps to define the historic character and therefore should always be a part of the rehabilitation plans.

Recommended	Not Recommended
Identifying, retaining, and preserving buildings, and streetscape, and landscape features which are important in defining the overall historic character of the district or neighborhood. Such features can include streets, alleys, paving, walkways, street lights, signs, benches, parks and gardens, and trees.	Removing or radically changing those features of the district or neighborhood which are important in defining the overall historic character so that, as a result, the character is diminished.
Retaining the historic relationship between buildings, and streetscape and landscape features such as a town square comprised of row houses and stores surrounding a communal park or open space.	Destroying streetscape and landscape features by widening existing streets, changing paving material, or introducing inappropriately located new streets or parking lots. Removing or relocating historic buildings, or features of the streetscape and landscape, thus destroying the historic relationship between buildings, features and open space.
Protecting and maintaining the historic masonry, wood, and architectural metals which comprise building and streetscape features, through appropriate surface treatments such as cleaning, rust removal, limited paint removal, and reapplication of protective coating systems; and protecting and maintaining landscape features, including plant material.	Failing to provide adequate protection of materials on a cyclical basis so that deterioration of building, streetscape, and landscape features results.
Protecting buildings, paving, iron fencing, etc. against arson and vandalism before rehabilitation work begins by erecting protective fencing and installing alarm systems that are keyed into local protection agencies.	Permitting buildings to remain unprotected so that windows are broken; and interior features are damaged. Stripping features from buildings or the streetscape such as wood siding, iron fencing, or terra cotta balusters; or removing or destroying landscape features, including plant material.

Recommended	Not Recommended
Evaluating the overall condition of building, streetscape and landscape materials to determine whether more than protection and maintenance are required, that is, if repairs to features will be necessary.	Failing to undertake adequate measures to assure the preservation of building, streetscape, and landscape features.
Repairing features of the building, streetscape, or landscape by reinforcing the historic materials. Repair will also generally include the replacement in kind--or with a compatible substitute material--of those extensively deteriorated or missing parts of features when there are surviving prototypes such as porch balustrades, paving materials, or streetlight standards.	Replacing an entire feature of the building, streetscape, or landscape such as a porch, walkway, or streetlight, when repair of materials and limited replacement of deteriorated or missing parts are appropriate. Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the building, streetscape, or landscape feature or that is physically or chemically incompatible.
Replacing in kind an entire feature of the building, streetscape, or landscape that is too deteriorated to repair--when the overall form and detailing are still evident--using the physical evidence to guide the new work. This could include a storefront, a walkway, or a garden. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.	Removing a feature of the building, streetscape, or landscape that is unrepairable and not replacing it; or replacing it with a new feature that does not convey the same visual appearance.

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Design for Missing Historic Features

Recommended	Not Recommended
Designing and constructing a new feature of the building, streetscape, or landscape when the historic feature is completely missing, such as row house steps, a porch, streetlight, or terrace. It may be a restoration based on historical, pictorial, and physical documentation; or be a new design that is compatible with the historic character of the district or neighborhood.	Creating a false historical appearance because the replaced feature is based on insufficient historical, pictorial and physical documentation. Introducing a new building, streetscape or landscape feature that is out of scale or otherwise inappropriate to the setting's historic character, e.g., replacing picket fencing with chain link fencing.

Recommended	Not Recommended
Alterations/Additions for the New Use	
Designing required new parking so that it is as unobtrusive as possible, i.e., on side streets or at the rear of buildings. "Shared" parking should also be planned so that several businesses can utilize one parking area as opposed to introducing random, multiple lots.	Placing parking facilities directly adjacent to historic buildings which cause the removal of historic plantings, relocation of paths and walkways, or blocking of alleys.
Designing and constructing new additions to historic buildings when required by the new use. New work should be compatible with the historic character of the district or neighborhood in terms of size, scale, design, material, color, and texture.	Introducing new construction into historic districts that is visually incompatible or that destroys historic relationships within the district or neighborhood.
Removing nonsignificant buildings, additions, or streetscape and landscape features which detract from the historic character of the district or the neighborhood.	Removing a historic building, building feature, or landscape or streetscape feature that is important in defining the overall historic character of the district or the neighborhood.

Although the work in these sections is quite often an important aspect of rehabilitation projects, it is usually <u>not</u> part of the overall process of preserving character-defining features (maintenance, repair, replacement); rather, such work is assessed for its potential negative impact on the building's historic character. For this reason, particular care must be taken not to obscure, radically change, damage, or destroy character-defining features in the process of rehabilitation work to meet new use requirements.

HEALTH AND SAFETY CODE REQUIREMENTS

As a part of the new use, it is often necessary to make modifications to a historic building so that it can comply with current health, safety and code requirements. Such work needs to be carefully planned and undertaken so that it does not result in a loss of character-defining spaces, features, and finishes.

Recommended	Not Recommended
Identifying the historic building's character-defining spaces, features, and finishes so that code-required work will not result in their damage or loss.	Undertaking code-required alterations to a building or site before identifying those spaces, features, or finishes which are character-defining and must therefore be preserved.
Complying with health and safety codes, including seismic codes and barrier-free access requirements, in such a manner that character-defining spaces, features, and finishes are preserved.	Altering, damaging, or destroying character-defining spaces, features, and finishes while making modifications to a building or site to comply with safety codes.
Working with local code officials to investigate alternative life safety measures or variances available under some codes so that alterations and additions to historic buildings can be avoided.	Making changes to historic buildings without first seeking alternatives to code requirements.
Providing barrier-free access through removable or portable, rather than permanent, ramps.	Installing permanent ramps that damage or diminish character-defining features.
Providing seismic reinforcement to a historic building in a manner that avoids damaging the structural system and character-defining features.	Reinforcing a historic building using measures that damage or destroy character-defining structural and other features.
Upgrading historic stairways and elevators to meet health and safety codes in a manner that assures their preservation, i.e., so that they are not damaged or obscured.	Damaging or obscuring historic stairways and elevators or altering adjacent spaces in the process of doing work to meet code requirements.
Installing sensitively designed fire suppression systems, such as a sprinkler system for wood frame mill buildings, instead of applying fire-resistant sheathing to character-defining features.	Covering character-defining wood features with fire-resistant sheathing which results in altering their visual appearance.

Recommended	Not Recommended
Applying fire-retardant coatings, such as intumescent paints, which expand during fire to add thermal protection to steel.	Using fire-retardant coatings if they damage or obscure character-defining features.
Adding a new stairway or elevator to meet health and safety codes in a manner that preserves adjacent character-defining features and spaces.	Radically changing, damaging, or destroying character-defining spaces, features, or finishes when adding a new code-required stairway or elevator.
Placing a code-required stairway or elevator that cannot be accommodated within the historic building in a new exterior addition. Such an addition should be located at the rear of the building or on an inconspicuous side; and its size and scale limited in relationship to the historic building.	Constructing a new addition to accommodate code-required stairs and elevators on character-defining elevations highly visible from the street; or where it obscures, damages or destroys character-defining features.

ENERGY RETROFITTING

Some character-defining features of a historic building or site such as cupolas, shutters, transoms, skylights, sun rooms, porches, and plantings also play a secondary energy conserving role. Therefore, prior to retrofitting historic buildings to make them more energy efficient, the first step should always be to identify and evaluate the existing historic features to assess their inherent energy conserving potential. If it is determined that retrofitting measures are necessary, then such work needs to be carried out with particular care to insure that the building's historic character is preserved in the the process of rehabilitation.

Recommended	Not Recommended
District/Neighborhood	
Maintaining those existing landscape features which moderate the effects of the climate on the setting such as deciduous trees, evergreen wind-blocks, and lakes or ponds.	Stripping the setting of landscape features and landforms so that the effects of the wind, rain, and the sun result in accelerated deterioration of historic materials.
Building Site	
Retaining plant materials, trees, and landscape features, especially those which perform passive solar energy functions such as sun shading and wind breaks.	Removing plant materials, trees, and landscape features, so that they no longer perform passive solar energy functions.
Installing freestanding solar collectors in a manner that preserves the historic property's character-defining features.	Installing freestanding solar collectors that obscure, damage, or destroy historic landscape or archeological features.
Designing attached solar collectors, including solar greenhouses, so that the character-defining features of the property are preserved.	Locating solar collectors where they radically change the property's appearance; or damage or destroy character-defining features.

Masonry/Wood/Architectural Metals

Recommended	Not Recommended
Installing thermal insulation in attics and in unheated cellars and crawlspaces to increase the efficiency of the existing mechanical systems.	Applying urea formaldehyde foam or any other thermal insulation with a water content into wall cavities in an attempt to reduce energy consumption.
Installing insulating material on the inside of masonry walls to increase energy efficiency where there is no character-defining interior moulding around the window or other interior architectural detailing.	Resurfacing historic building materials with more energy efficient but incompatible materials, such as covering historic masonry with exterior insulation.
Installing passive solar devices such as a glazed "trombe" wall on a rear or inconspicuous side of the historic building.	Installing passive solar devices such as an attached glazed "trombe" wall on primary or other highly visible elevations; or where historic material must be removed or obscured.

Roofs

Recommended	Not Recommended
Placing solar collectors on non-character-defining roofs or roofs of nonhistoric adjacent buildings.	Placing solar collectors on roofs when such collectors change the historic roofline or obscure the relationship of the roof to character-defining roof features such as dormers, skylights, and chimneys.

Windows

Recommended	Not Recommended
Utilizing the inherent energy conserving features of a building by maintaining windows and louvered blinds in good operable condition for natural ventilation.	Removing historic shading devices rather than keeping them in an operable condition.
Improving thermal efficiency with weatherstripping, storm windows, [illegible]	Replacing historic [illegible]

Recommended	Not Recommended
Windows (continued)	
Installing exterior storm windows which do not damage or obscure the windows and frames.	Installing new exterior storm windows which are inappropriate in size or color, which are inoperable.
	Replacing windows or transoms with fixed thermal glazing or permitting windows and transoms to remain inoperable rather than utilizing them for their energy conserving potential.
Considering the use of lightly tinted glazing on non-character-defining elevations if other energy retrofitting alternatives are not possible.	Using tinted or reflective glazing on character-defining or other conspicuous elevations.
Entrances and Porches	
Utilizing the inherent energy conserving features of a building by maintaining porches, and double vestibule entrances, in good condition so that they can retain heat or block the sun and provide natural ventilation.	Enclosing porches located on character-defining elevations to create passive solar collectors or airlock vestibules. Such enclosures can destroy the historic appearance of the building.
Interior Features	
Retaining historic interior shutters and transoms for their inherent energy conserving features.	Removing historic interior features which play a secondary energy conserving role.
New Additions to Historic Buildings	
Placing new additions that have an energy conserving function such as a solar greenhouse on non-character-defining elevations.	Installing new additions such as multi-story solar greenhouse additions which obscure, damage, destroy character-defining features.
Mechanical Systems	
Installing thermal insulation in attics and in unheated cellars and crawlspaces to conserve energy.	Applying urea formaldehyde foam or any other thermal insulation with a water content or that may collect moisture into wall cavities.

NEW ADDITIONS TO HISTORIC BUILDINGS

An attached exterior addition to a historic building expands its "outer limits" to create a new profile. Because such expansion has the capability to radically change the historic appearance, an exterior addition should be considered only after it has been determined that the new use cannot be successfully met by altering non-character-defining interior spaces. If the new use cannot be met in this way, then an attached exterior addition is usually an acceptable alternative. New additions should be designed and constructed so that the character-defining features of the historic building are not radically changed, obscured, damaged, or destroyed in the process of rehabilitation. New design should always be clearly differentiated so that the addition does not appear to be part of the historic resource.

Recommended	Not Recommended
Placing functions and services required for the new use in non-character-defining interior spaces rather than installing a new addition.	Expanding the size of the historic building by constructing a new addition when the new use could be met by altering non-character-defining interior spaces.
Constructing a new addition so that there is the least possible loss of historic materials and so that character-defining features are not obscured, damaged, or destroyed.	Attaching a new addition so that the character-defining features of the historic building are obscured, damaged, or destroyed.
Locating the attached exterior addition at the rear or on an inconspicuous side of a historic building; and limiting its size and scale in relationship to the historic building.	Designing a new addition so that its size and scale in relation to the historic building are out of proportion, thus diminishing the historic character.
Designing new additions in a manner that makes clear what is historic and what is new.	Duplicating the exact form, material, style, and detailing of the historic building in the new addition so that the new work appears to be part of the historic building.
	Imitating a historic style or period of architecture in new additions, especially for contemporary uses such as drive-in banks or garages.

Recommended	Not Recommended
Considering the attached exterior addition both in terms of the new use and the appearance of other buildings in the historic district or neighborhood. Design for the new work may be contemporary or may reference design motifs from the historic building. In either case, it should always be clearly differentiated from the historic building and be compatible in terms of mass, materials, relationship of solids to voids, and color.	Designing and constructing new additions that result in the diminution or loss of the historic character of the resource, including its design, materials, workmanship, location, or setting. Using the same wall plane, roof line, cornice height, materials, siding lap or window type to make additions appear to be a part of the historic building.
Placing new additions such as balconies and greenhouses on non-character-defining elevations and limiting the size and scale in relationship to the historic building.	Designing new additions such as multi-story greenhouse additions that obscure, damage, or destroy character-defining features of the historic building.
Designing additional stories, when required for the new use, that are set back from the wall plane and are as inconspicuous as possible when viewed from the street.	Constructing additional stories so that the historic appearance of the building is radically changed.

READING LIST AND ORDERING INFORMATION

Preservation Tax Incentives Program Information

* Tax Incentives for Rehabilitating Historic Buildings. Program leaflet. Explains the Federal tax incentives available to owners who rehabilitate commercial historic structures. Includes an outline of the certification process, program regulations, and a list of State Historic Preservation Officers. 12 pages. May, 1982.

Preservation Briefs are prepared for property owners, developers, or Federal agency managers to assist in evaluating and resolving common preservation and repair problems. The briefs are often given to preservation tax incentives program applicants to help explain recommended historic preservation method and approaches in the rehabilitation of historic buildings. Copies, except where noted, are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. GPO prices are subject to change without notice.

* Preservation Briefs: 1. The Cleaning and Waterproof Coating of Masonry Buildings by Robert C. Mack, AIA. Provides guidance on the techniques of cleaning and waterproofing and explains the consequences of their inappropriate use. 4 pages. 5 illus. November, 1975.

Preservation Briefs: 2. Repointing Mortar Joints in Historic Brick Buildings by Robert C. Mack, AIA, de Teel Patterson Tiller, and James S. Askins. Provides update on appropriate materials and methods for repointing historic buildings. 8 pages. 12 illus. August, 1980. GPO Stock Number 024-016-00148-6: 1-100 copies, $2.25 each; multiples of 100, $22.

Preservation Briefs: 3. Conserving Energy in Historic Buildings by Baird M. Smith, AIA. Provides information on materials and techniques to consider or avoid when undertaking weatherization and energy conservation measures in historic buildings. 8 pages. 8 illus. April, 1978. GPO Stock Number: 024-016-00103-6: 1-100 copies, $2.25 each; multiples of 100, $22.

Preservation Briefs: 4. Roofing for Historic Buildings by Sarah M. Sweetser. Provides a brief history of the most commonly used roofing materials in America. Presents a sound preservation approach to roof repair, roof replacement, and the use of alternative roofing materials. 8 pages. 15 illus. February, 1978. GPO Stock Number: 024-016-00102-8; 1-100 copies, $2.25 each; multiples of 100, $22.

* Preservation Briefs: 5. The Preservation of Historic Adobe Buildings. Provides information on the traditional materials and construction of adobe buildings, and the causes of adobe deterioration. Makes recommendations for preserving historic adobe buildings. 8 pages. 10 illus. August, 1978.

* Unavailable from the Government Printing Office. Single copies available from the National Park Service Regional Offices (see Introduction to Guidelines).

Preservation Briefs: 6. Dangers of Abrasive Cleaning to Historic Buildings by Anne E. Grimmer. Cautions against the use of sandblasting to clean various buildings and suggests measures to mitigate the effects of improper cleaning. Explains the limited circumstances under which abrasive cleaning may be appropriate. 8 pages. 10 illus. June, 1979. GPO Stock Number: 024-016-00112-5: 1-100 copies, $2.25 each; multiples of 100, $22.

Preservation Briefs: 7. The Preservation of Historic Glazed Architectural Terra-Cotta by de Teel Patterson Tiller. Discusses deterioration problems that commonly occur with terra-cotta and provides methods for determining the extent of such deterioration. Makes recommendations for maintenance and repair, and suggests appropriate replacement materials. 8 pages. 11 illus. June, 1979. GPO Stock Number: 024-016-00115-0: 1-100 copies, $2.25 each; multiples of 100, $22.

Preservation Briefs: 8. Aluminum and Vinyl Sidings on Historic Buildings by John H. Myers. Discusses esthetic and technical considerations surrounding use of these substitute replacement materials. 8 pages. 11 illustrations. October, 1979. CURRENTLY OUT-OF-PRINT--TO BE REVISED AND REPRINTED IN 1983.

Preservation Briefs: 9. The Repair of Historic Wooden Windows by John H. Myers. Provides useful information on evaluating and repairing historic wooden windows found in typical rehabilitation projects. Emphasizes practical technology for homeowners or developers. 8 pages. 10 illustrations. January, 1981. GPO Stock Number: 024-016-00147-8: 1-100 copies, $2.25 each; multiples of 100, $22.

Preservation Briefs: 10. Exterior Paint Problems on Historic Woodwork by Kay D. Weeks and David W. Look, AIA. Identifies and describes common types of paint surface conditions and failures. Provides guidance on preparing historic woodwork for repainting, including limited and total paint removal. 12 pages. 14 illus. November, 1982. GPO Stock Number: 024-005-00842-0: $2.25 each.

Preservation Briefs: 11. Rehabilitating Historic Storefronts by H. Ward Jandl. Explores the role of the storefront in historic buildings and provides guidance on rehabilitation techniques for storefronts as well as compatible new storefront designs. 12 pages. 12 illus. November, 1982. GPO Stock Number: 024-005-00843-8: $2.25 each.

Technical Reports address in detail technical problems confronted by architects, engineers, government officials, and other technicians involved with the preservation of historic buildings. Copies, except where noted, are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. GPO prices are subject to change without notice.

Access to Historic Building for the Disabled: Suggestions for Planning and Implementation by Charles Parrott. Addresses the special concerns of improved access by disabled persons to historic buildings, as well as legal requirements and compliance planning procedures. Also examines techniques to make programs and services housed in historic buildings accessible in lieu of architectural changes. 92 pages. 42 illus. 1980. GPO Stock Number: 024-016-00149-4. $5.50.

Cyclical Maintenance for Historic Buildings by J. Henry Chambers, AIA. Provides a step-by-step process for building managers, architects, and others involved in the routine maintenance of historic properties. 125 pages. 1976. GPO Stock Number: 024-005-00637-1. $6.50.

** Directory of Historic Preservation Easement Organizations compiled by Charles E. Fisher, William G. MacRostie, and Christopher A. Sowick. Lists over 185 organizations throughout the nation who are willing to accept historic preservation easements. 23 pages. 3 illus. Rev., December, 1981.

Epoxies for Wood Repairs in Historic Buildings by Morgan W. Phillips and Judith E. Selwyn. Presents research findings on the formulations of epoxy consolidants and patching compounds for use on wooden elements in preservation projects, including case study applications. 72 pages. 43 illus. Appendix. 1978. GPO Stock Number: 024-016-00095-1. $5.00.

** Exterior Cleaning of Historic Masonry Buildings by Norman R. Weiss. Discusses various methods of cleaning and the complex factors to consider before selecting a suitable method. Intended primarily for architects, conservators, and other professionals responsible for the preparation of specifications and development of agency-wide cleaning programs. 18 pages. Selected bibliography. 1977.

Gaslighting in America: A Guide for Historic Preservation by Denys Peter Myers. Surveys interior and exterior gaslighting fixtures used in America, providing histories of the major manufacturing firms and a listing of the charter dates for individual and city gas companies. 248 pages. 120 illus. Appendix. Bibliography. 1978. GPO Stock Number: 024-016-00094-3. $8.50.

Metals in America's Historic Buildings: Uses and Preservation Methods by Margot Gayle and David W. Look, AIA (Part I); and John Waite (Part II). Concentrates on the historic uses of such architectural metals as lead, tin, zinc, copper, nickel, iron, steel, and aluminum (Part I). Also discusses the sources of metal deterioration and suggests appropriate preservation and maintenance techniques, addressing each metal individually (Part II). 170 pages. 180 illus. 1980. GPO Stock Number 024-016-00143-5. $7.00.

** Moving Historic Buildings by John Obed Curtis. Discusses the limited circumstances under which a historic masonry or frame building should be moved; establishes a methodology for planning, research, and recording prior to the move; and addresses the actual siting, foundation construction, building reassembly, and restoration after a successful move has taken place. 56 pages. 47 illus. Selected bibliography. 1979.

** Photogrammetric Recording of Cultural Resources by Perry E. Borchers. Describes the basic principles of photogrammetry and their application to the recording of cultural resources. 38 pages. 28 illus. 1977.

Rectified Photography and Photo Drawings for Historic Preservation by J. Henry Chambers, AIA. Presents a method developed for the preparation of photographic working drawings and photodocumentation. Intended for architects. 37 pages. 13 illus. 1973. GPO Stock Number: 024-016-00124-9. $4.75.

** Unavailable from the Government Printing Office. Requests for single copies may be sent to Technical Preservation Services, Preservation Assistance Division, National Park Service, Washington, D.C. 20240. Due to limited stock, copies of all materials requested may not be available.

Rehabilitation of Historic Buildings: An Annotated Bibliography by Frederec E. Kleyle. Cites readily available literature on various aspects of building rehabilitation with chapters on economics, building regulations, technical preservation topics, and selected case studies. 21 pages. 1980. GPO Stock Number: 024-016-00130-3. $3.50.

Wallpapers in Historic Preservation by Catherine Lynn Frangiamore. Surveys the technology, styles, and uses of wallpapers in America with suggestions for using wallpaper within a restoration project. 56 pages. 39 illus. Appendices. 1977. GPO Stock Number: 024-005-00685-1. $5.00.

** X-Ray Examination of Historic Structures by David M. Hart. Discusses a method for investigating a building's fabric by non-destructive means. Intended for architects, conservators, and other professionals. 24 pages. 19 illus. 1975.

** Unavailable from the Government Printing Office. Requests for single copies may be sent to: Technical Preservation Services, Preservation Assistance Division, National Park Service, Washington, D.C. 20240. Due to limited stock, copies of all materials requested may not be available.

TPS Publications: Outside The Government Printing Office

Some of the publications TPS has developed have been printed by the private sector and are only available from these non-governmental sources. The following list includes the sources' addresses:

Energy Conservation and Solar Energy for Historic Buildings: Guidelines for Appropriate Designs. Prepared for Technical Preservation Services, National Park Service, by Thomas Vonier Associates, Inc. funded by the U. S. Department of Energy. Provides design guidance on energy conservation measures and solar energy applications for historic buildings. 24 pages. 28 illus. November 1981. Available for $6.95, prepaid, from: The National Center for Architecture and Urbanism, 1927 S Street, N.W., Suite 300, Washington, D.C. 20009.

Respectful Rehabilitation: Answers to Your Questions on Historic Buildings. Prepared by Technical Preservation Services, National Park Service, U.S. Department of the Interior, and published by the Preservation Press of the National Trust for Historic Preservation. Provides answers to 150 questions which are often posed in the course of rehabilitating historic structures. Topics covered range from paint, wood, masonry, metals, and interior features to mechanical systems and health and safety codes. 185 pages. 150 illus. September 1982. Available for $9.95 plus $2.50 for postage and handling from: Preservation Shops, 1600 H Street, N.W., Washington, D.C. 20006.

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Exhibit GG

EXHIBIT GG.

PRESERVATION BRIEF #1: THE CLEANING AND WATERPROOF COATING OF MASONRY BUILDINGS

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NOVEMBER 1975

1 PRESERVATION BRIEFS


HABS

The Cleaning and Waterproof Coating of Masonry Buildings

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Interagency Historic Architectural Services Program

Office of Archeology and Historic Preservation / National Park Service

The inappropriate cleaning and waterproofing of masonry buildings is a major cause of deterioration of the Nation's historic resources. While both treatments may be appropriate in some cases, they may cause serious deterioration in others. The purpose of this leaflet is to provide guidance on the techniques of cleaning and waterproofing, and to explain the consequences of their inappropriate use.

Why Clean?

The reasons for cleaning any building must be considered carefully before arriving at a decision to clean.

– Is the cleaning being done to improve the appearance of the building or to make it look new? The so-called "dirt" actually may be weathered masonry, not accumulated deposits; a portion of the masonry itself thus will be removed if a "clean" appearance is desired.
– Is there any evidence that dirt and pollutants are having a harmful effect on the masonry? Improper cleaning can accelerate the deteriorating effect of pollutants.
– Is the cleaning an effort to "get your project started" and improve public relations? Cleaning may help local groups with short term fund raising, yet cause long term damage to the building.

These concerns may lead to the conclusion that cleaning is not desirable—at least not until further study is made of the building, its environment and possible cleaning methods.

What Is The Dirt?

The general nature and source of dirt on a building must be determined in order to remove it in the most effective, yet least harmful, manner. Soot and smoke, for example, may require a different method of cleaning than oil stains or bird droppings. The "dirt" also may be a weathered or discolored portion of the masonry itself rather than extraneous materials. Removal of part of the masonry thus would be required to obtain a "clean" appearance, leading to loss of detail and gradual erosion of the masonry. Other common cleaning problems include metal stains such as rust or copper stains, and organic matter such as the tendrils left on the masonry after removal of ivy. The source of dirt, such as coal soot, may no longer be a factor in planning for longer term maintenance, or it may be a continuing source of problems. Full evaluation of dirt and its effect on the building may require one or several kinds of expertise: consultants may include building conservators, geologists, chemists, and preservation architects. Other sources of local experience or information may include building owners in the area, local universities, the State Historic Preservation Officer, and the AIA State Preservation Coordinator.

If the proposed cleaning is to remove paint, it is important in each case to learn whether or not exposed brick is historically appropriate. Many buildings were painted at the time of construction or shortly thereafter; retention of the paint, therefore, may be more appropriate historically than exposing the brick, in spite of current attitudes about "natural" brick. Even in cases where unpainted masonry is appropriate, the retention of the paint may be more practical than removal in terms of long range preservation of the masonry. In some cases, however, removal of the paint may be desirable. For example, the old paint layers may have built up to such an extent that removal is necessary prior to repainting. It is essential, however, that research on the paint type, color, and layering be completed on the entire building before removal.

What Is The Construction Of The Building?

The construction of the building must be considered in developing a cleaning program because inappropriate cleaning can have a corrosive effect on both the masonry and the other building materials.

Incorrectly chosen cleaning products can cause damaging chemical reactions with the masonry itself. For example, the effect of acidic cleaners on marble and limestone generally is recognized. Other masonry products also are subject to adverse chemical reactions with incompatible cleaning products. Thorough understanding of the physical and chemical properties of the masonry can help you avoid the inadvertent selection of damaging cleaning materials.

Other building materials also may be affected by the cleaning process; some chemicals, for example, may have a corrosive effect on paint or glass. The portions of building elements most vulnerable to deterioration may not be visible, such as embedded ends of iron window bars. Other totally unseen items, such as iron cramps or ties which hold the masonry to the structural frame, also may be subject to corrosion from the use of chemicals or even from plain water (Fig. 1). The only way to prevent problems in these cases is to study the building construction in detail and evaluate proposed cleaning methods with this information in mind.

Previous treatments of the building and its surroundings also should be evaluated, if known. Earlier waterproofing applications may make cleaning difficult. Repairs may have been stained to match the building, and cleaning may make

Figure 1. The iron anchor shown here originally was hidden from view. An increase in volume due to rusting created internal pressures on the stone and brick, causing spalling. Careful study of the building construction can result in the identification of these potential problem areas and they can be taken into consideration while planning a cleaning project.

these differences apparent. Salts or other snow removal chemicals used near the building may have dissolved and been absorbed into the masonry, causing potentially serious problems of spalling or efflorescence. Techniques for overcoming each of these problems should be considered prior to the selection of a cleaning method.

Types Of Cleaning

Cleaning methods generally are divided into three major groups: water, chemical, and mechanical (abrasive). Water methods soften the dirt and rinse the deposits from the surface. Chemical cleaners react with the dirt and/or masonry to hasten the removal process; the deposits, reaction products and excess chemicals then are rinsed away with water. Mechanical methods include grit blasting (usually sand blasting), grinders, and sanding discs, which remove the dirt by abrasion and usually are followed by a water rinse. Problems related to each of these cleaning methods will be discussed later in this leaflet.

Planning A Cleaning Project

Once the existing conditions have been evaluated, including the type of dirt and the building materials, planning for the cleaning project can begin.

Environmental concerns: The potential effect of each proposed method of cleaning should be evaluated carefully. Chemical cleaners, even though dilute, may damage trees, shrubs, grass, and plants. Animal life, ranging from domestic pets to song birds to earth worms, also may be affected by the run-off. In addition, mechanical methods can produce hazards through the creation of airborne dust.

The proposed cleaning project also may cause property damage. Wind drift, for example, may carry cleaning

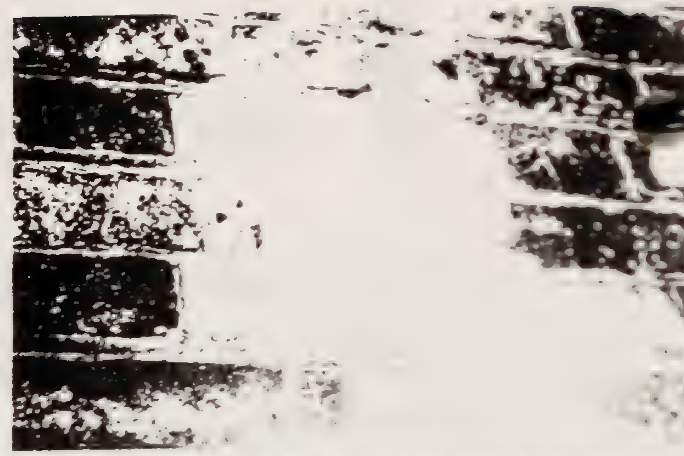


Figure 2. The white [illegible] on the surface of the [illegible] masonry or mortar migrate from the [illegible] action, or are brought in [illegible] result of chemical reactions [illegible] cleaner.

chemicals onto ne[illegible] glass or spotting of th[illegible] can enter surrounding buildings [illegible] in nearby yards and [illegible]

Personal safety. The [illegible] proposed for the cleaning [illegible] the dangers [illegible] chemical cleaners [illegible] operators and passers-by [illegible] in both liquid and [illegible] dust which can [illegible] the abrasive or the [illegible] serious hazards be[illegible]

Testing cleaning methods. [illegible] methods should [illegible] on the building. [illegible] should be included [illegible] too often simple methods [illegible] are not even [illegible] safe, and least [illegible] with a mild [illegible] effective. It is [illegible] tested prior to [illegible] for the building [illegible] expensive.

The level of [illegible] prior to selection of a cleaning [illegible] of cleaning is to [illegible] appearance, however, [illegible] building, and [illegible] It [illegible] acceptable [illegible] considered [illegible] masonry and [illegible]

Cleaning tests, whether [illegible] methods, should [illegible] give a true indication of [illegible] include at [illegible] include [illegible] remembered that [illegible] masonry materials [illegible] surface finishes [illegible] separately. *[illegible] several methods of [illegible] building.*

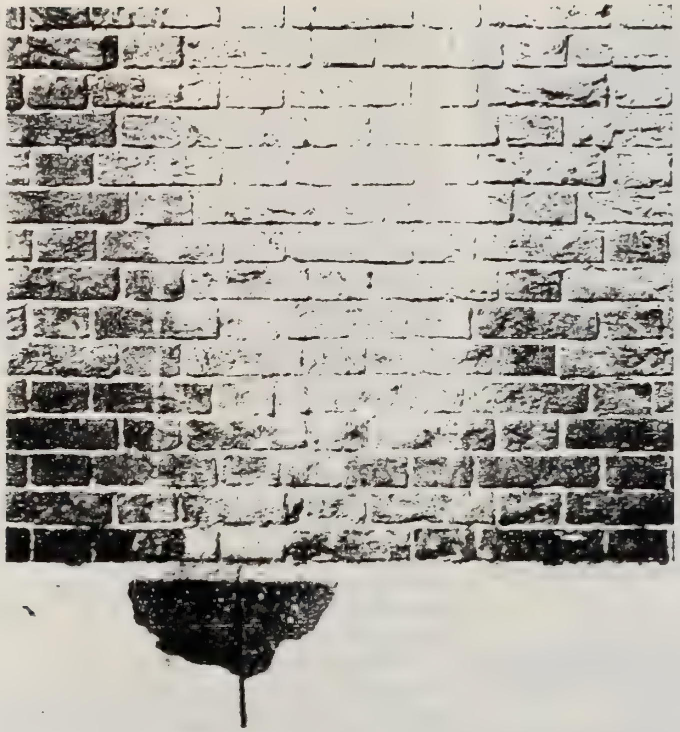


Figure 3. The hazy appearance of a portion of the brick is caused by a residue resulting from cleaning. This film occurred in spite of thorough rinsing. Test patches such as this should always be allowed to weather prior to continuing with the cleaning.

The cleaning budget should include money to pay for these tests. Usually contractors are more willing to conduct a variety of tests if they are reimbursed for their time and materials, particularly if the tests include methods with which the contractor is not familiar.

When feasible, test areas should be allowed to weather for an extended period prior to evaluation. A waiting period of a full year is not unreasonable in order to expose the masonry to a full range of seasons. For any building which is considered historically important, the delay is insignificant compared to the potential damage and disfigurement which may arise from use of an incompletely tested method (Figs. 2-5).

Potential Problems Of Cleaning

Water Cleaning: Water cleaning methods include: (1) low pressure wash over an extended period, (2) moderate to high pressure wash, and (3) steam. Bristle brushes frequently are used to supplement the water wash. All joints, including mortar and sealants, must be sound in order to minimize water penetration to the interior.

Porous masonry may absorb excess amounts of water during the cleaning process and cause damage within the wall or on interior surfaces. Normally, however, water penetrates only part way through even moderately absorbant masonry materials.

Excess water also can bring soluble salts from within the masonry to the surface, forming efflorescences (Fig. 2); in dry climates, the water may evaporate inside the masonry, leaving the salts slightly in back of the surface. The damage which can be caused by soluble salts is explained in more detail later in this leaflet. Efflorescence usually can be traced to a source other than a single water wash.

Another source of surface disfigurement is chemicals such as iron and copper in the water supply; even "soft" water may contain deleterious amounts of these chemicals. Water methods cannot be used during periods of cold

Figure 4. Sandblasting has rounded the corners of this marble capital and pitted the formerly smooth surface. Not only is the stone harmed visually, the increased roughness of the surface also will collect new dirt more quickly than smooth stone.

weather because water within the masonry can freeze, causing spalling and cracking. Since a wall may take over a week to dry after cleaning, no water cleaning should be permitted for several days prior to the first average frost date, or even earlier if local forecasts predict cold weather.

In spite of these potential problems, water methods generally are the simplest to carry out, the safest for the building and the environment, and the least expensive.

Chemical cleaning: Since most chemical cleaners are water based, they have many of the potential problems of plain water. Additional problems of chemical cleaning agents have been mentioned in the discussion of environmental concerns.

Chemical cleaners have other problems as well. Some types of masonry are subject to direct attack by cleaning chemicals. Marble and limestone, for example, are dissolved easily by acidic cleaners, even in dilute forms. Another problem may be a change in the color of the masonry caused by the chemicals, not by removal of dirt; the cleaner also may leave a hazy residue in spite of heavy rinsing (Fig. 3). In addition, chemicals can react with components of mortar, stone, or brick to create soluble salts which can form efflorescences, as mentioned earlier. Historic brick buildings are particularly susceptible to damage from hydrochloric (muriatic) acid, although it is, unfortunately, widely used on these structures.

Mechanical cleaning: Grit blasters, grinders, and sanding discs all operate by *abrading the dirt off the surface* of the masonry, rather than reacting with the dirt and masonry as in water and chemical methods. Since the abrasives do not differentiate between the dirt and the masonry, *some erosion of the masonry surface is inevitable with mechanical methods, especially blasting.* Although a skilled operator can minimize this erosion, some erosion will still take place. In the case of brick, soft stone, detailed carvings, or polished surfaces, even minimal erosion is unacceptable (Figs. 4 and 5). Brick, a fired product, is hardest on the outside where the temperatures were highest; the loss of this "skin" of the brick exposes the softer inner portion to more rapid deterioration. Abrasion of intricate details causes a rounding of sharp corners and other loss of delicate features, while abrasion of polished surfaces removes the polished quality of stone. Mechanical methods, therefore, should never be used on these surfaces and should be used with extreme caution on others.

Grit blasting, unfortunately, still is widely used in spite of these serious effects. In most cases, blasting will leave

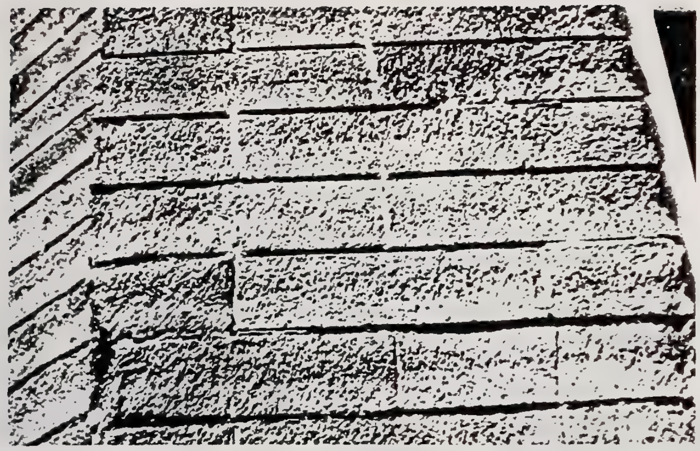


Figure 5. This brickwork was sandblasted to remove paint. Note the severe erosion which has occurred, especially in the softer center sections of this "hard burned" late 19th-century brick. Although this is a severe example, the same problem of increased roughness and porosity will occur even on more skillfully performed jobs where the effect is less evident visually.

minute pits on the surface of the masonry. This additional roughness actually increases the surface area on which new dirt can settle and on which pollutants can react.

Mortar joints, especially those with lime mortar, also can be eroded by mechanical cleaning. In some cases, the damage may be visual, such as loss of joint detail or increased joint shadows. Joints constitute a significant portion of the masonry surface (up to 20% in a brick wall) so this change should not be considered insignificant. In other cases, however, the erosion of the mortar joint may permit increased water penetration, leading to the necessity for complete repointing.

Other problems of mechanical methods have been mentioned in the discussion of project planning. In addition, wet blasting or water rinses can create the potential hazards of water methods.

Problems Of Water Repellent And Waterproof Coatings

Is waterproofing necessary? Coatings frequently are applied to historic buildings without concern for the requirement or the consequences of the coating. Most historic buildings have survived for years without coatings, so why are they needed now? Water penetration to the interior usually is not caused by porous masonry but by deteriorated gutters and downspouts, deteriorated mortar, capillary moisture from the ground (rising damp), or condensation. Coatings will not solve these problems. In the case of rising damp, in fact, the coatings will allow the water to go even higher because of the retarded rate of evaporation. The claim also is made that coatings keep dirt and pollutants from collecting on the surface of the building thus reducing the requirement for future cleaning. While this at times may be true, at other times the coatings actually retain the dirt more than uncoated masonry. More important, however, is the fact that these coatings can cause greater deterioration of the masonry than that caused by pollution, so the treatment may be worse than the problem one is attempting to solve.

Types of coatings: Masonry coatings are of two types: water*proof* coatings and water *repellent* coatings. Waterproof coatings seal the surface from liquid water and from water vapor; they usually are opaque, such as bituminous coatings and some paints. Water repellents keep liquid water from penetrating the surface but allow water vapor to enter and leave through the "pores" of the masonry. They usually are transparent, such as the silicone coatings, although they may change the reflective property of the masonry, thus changing the appearance.

Waterproof coatings: These coatings usually do not [illegible] problems as long as they exclude *all* water from the mas[illegible]. If water does enter the wall, however, the coating [illegible] intensify the damage because the water will not be able to escape. During cold weather this water in the wall can freeze, causing serious mechanical disruption, such as spalling. In addition, the water eventually will get out by the path of least resistence. If this path is toward the interior, damage to interior finishes can result; if it is toward exterior, cracks in the coating, it can lead to damage from the build-up of salts as described below.

Water repellent coatings: These coatings also can cause serious damage, but by a somewhat different mechanism. As water repellent coatings do not seal the surface to water vapor, it can enter the wall as well as leave the wall. Once inside the wall, the vapor can condense at [illegible], producing liquid water. Water within the wall, whether from condensation, leaking gutters, or other sources, can do damage, as explained earlier

Further damage can be done by soluble salts. Salts frequently are present in the masonry, either from the mortar or from the masonry units themselves. Liquid water can dissolve these salts and carry them toward the surface. If the water is permitted to come to the surface, efflorescence [illegible] appear upon evaporation. These are unsightly but usually are easily removed; they often are washed away by the simple action of the rain.

The presence of a water repellent coating, however, prevents the water and dissolved salts from coming completely to the surface. The salts then are deposited slightly behind the surface of the masonry as the [illegible] evaporates through the pores. Over time, the salt crystals [illegible] grow and will develop substantial pressures which will spall the masonry, detaching it at the depth of crystal growth. This build-up may take several years to cause problems.

Test patches for coatings generally do not allow an adequate evaluation of the treatment, because water may enter and leave through the surrounding untreated areas, thus flushing away the salt build-up. In addition, salt deposits may not cause visible damage for several years, well after the patch has been evaluated

This is not to suggest that there is never a use for water repellents or waterproofings. Sandblasted brick, for example, may have become so porous that paint or some type of coating is essential. In other cases, the damage being caused by local pollution may be greater than the potential damage from the coatings. Generally, coatings are not necessary, however, unless there is a specific problem which they will help to solve. If the problem occurs on only a portion of the masonry, it probably is best to treat only the problem area rather than the entire building. Extreme exposures such as parapets, for example, or portions of the building subject to driving rains can be treated more effectively and less expensively than the entire building.

This publication has been prepared [illegible] Executive Order 11593, "Protection and Enhancement of the Cultural Environment," which directs the Secretary of the Interior to "... [illegible] available to Federal agencies and State and local governments information concerning professional methods and techniques for preserving, improving, restoring and maintaining historic properties." It has been written by Robert C. Mack, AIA, [illegible] Historic Architectural Services Program, Office of Archeology and Historic Preservation, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240, [illegible]

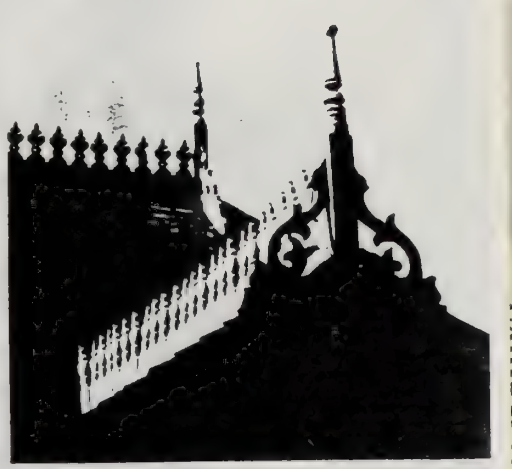
Exhibit HH

EXHIBIT HH.

PRESERVATION BRIEF #4:
ROOFING FOR HISTORIC BUILDINGS

SARAH M. SWEETSER
FEBRUARY 1978

4 PRESERVATION BRIEFS



Roofing for Historic Buildings

Sarah M. Sweetser

Technical Preservation Services Division
Office of Archeology and Historic Preservation/
Heritage Conservation and Recreation Service

Significance of the Roof

A weather-tight roof is basic in the preservation of a structure, regardless of its age, size, or design. In the system that allows a building to work as a shelter, the roof sheds the rain, shades from the sun, and buffers the weather.

During some periods in the history of architecture, the roof imparts much of the architectural character. It defines the style and contributes to the building's aesthetics. The hipped roofs of Georgian architecture, the turrets of Queen Anne, the Mansard roofs, and the graceful slopes of the Shingle Style and Bungalow designs are examples of the use of roofing as a major design feature.

But no matter how decorative the patterning or how compelling the form, the roof is a highly vulnerable element of a shelter that will inevitable fail. A poor roof will permit the accelerated deterioration of historic building materials—masonry, wood, plaster, paint—and will cause general disintegration of the basic structure. Furthermore, there is an urgency involved in repairing a leaky roof since such repair costs will quickly become prohibitive. Although such action is desirable as soon as a failure is discovered, temporary patching methods should be carefully chosen to prevent inadvertent damage to sound or historic roofing materials and related features. Before any repair work is performed, the historic value of the materials used on the roof should be understood. Then a complete internal and external inspection of the roof should be planned to determine all the causes of failure and to identify the alternatives for repair or replacement of the roofing.

Historic Roofing Materials in America

Clay Tile: European settlers used clay tile for roofing as early as the mid-17th century; many pantiles (S-curved tiles), as well as flat roofing tiles, were used in Jamestown, Virginia. In some cities such as New York and Boston, clay was popularly used as a precaution against such fire as those that engulfed London in 1666 and scorched Boston in 1679.

Tiles roofs found in the mid-18th century Moravian settlements in Pennsylvania closely resembled those found in Germany. Typically, the tiles were 14–15″ long, 6–7″ wide with a curved butt. A lug on the back allowed the tiles to hang on the lathing without nails or pegs. The tile surface was usually scored with finger marks to promote drainage. In the Southwest, the tile roofs of the Spanish missionaries (mission tiles) were first manufactured (ca. 1780) at the Mission San Antonio de Padua in California. These semicircular tiles were made by molding clay over sections of logs, and they were generally 22″ long and tapered in width.

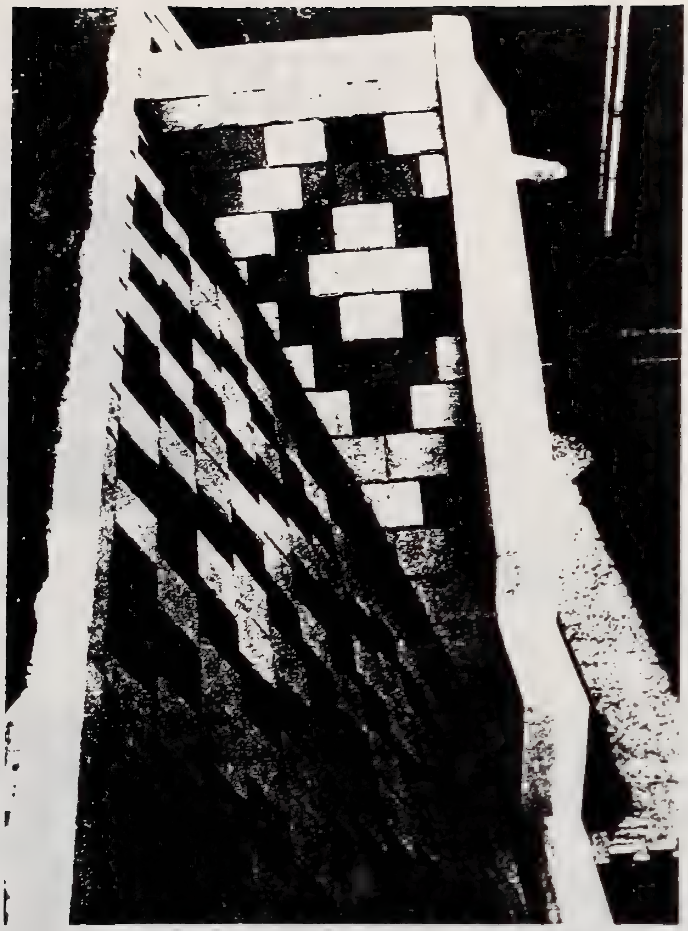
Repairs on this pantile roof were made with new tiles held in place with metal hangers. (Main Building, Ellis Island, New York)

The plain or flat rectangular tiles most commonly used from the 17th through the beginning of the 19th century measured about 10″ by 6″ by ½″, and had two holes at one end for a nail or peg fastener. Sometimes mortar was applied between the courses to secure the tiles in a heavy wind.

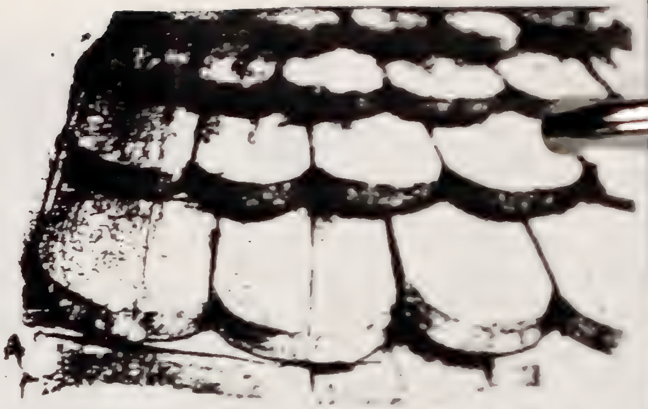
In the mid-19th century, tile roofs were often replaced by sheet-metal roofs, which were lighter and easier to install and maintain. However, by the turn of the century, the Romanesque Revival and Mission style buildings created a new demand and popularity for this picturesque roofing material.

Slate: Another practice settlers brought to the New World was slate roofing. Evidence of roofing slates have been found also among the ruins of mid-17th-century Jamestown. But because of the cost and the time required to obtain the material, which was mostly imported from Wales, the use of slate was initially limited. Even in Philadelphia (the second largest city in the English-speaking world at the time of the Revolution) slates were so rare that "The Slate Roof House" distinctly referred to William Penn's home built late in the 1600s. Sources of native slate were known to exist along the eastern seaboard from Maine to Virginia, but difficulties in inland transportation limited its availability to the cities, and contributed to its expense. Welsh slate continued to be imported until the development of canals and railroads in the mid-19th century made American slate more accessible and economical.

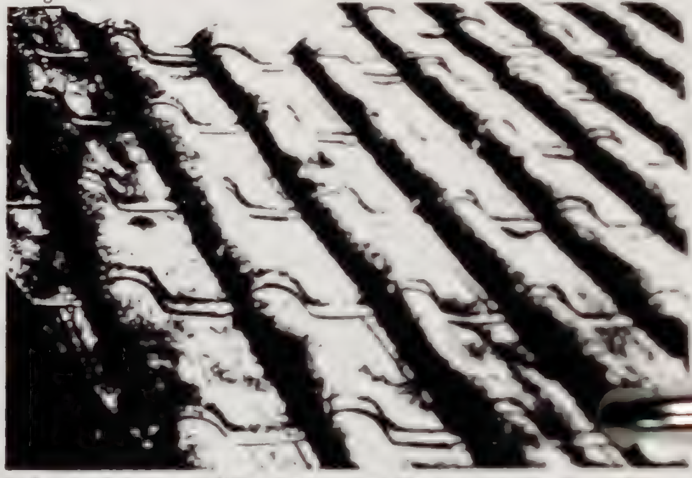
Slate was popular for its durability, fireproof qualities, and



The Victorians loved to used different colored slates to create decorative patterns on their roofs, an effect which cannot be easily duplicated by substitute materials. Before any repair work on a roof such as this, the slate sizes, colors, and position of the patterning should be carefully recorded to assure proper replacement. (Ebenezer Maxwell Mansion, Philadelphia, Pennsylvania, photo courtesy of William D. Hershey)



Replacement of particular historic details is important to the individual historic character of a roof, such as [illegible] of this rounded butt wood shingle roof. Also note that the pattern of the roof was carefully swept to create a curved slope from the side of a dormer. In the restoration, this pattern was duplicated with the addition of carefully concealed modern metal flashing. (Mount Vernon, Virginia)



Galvanized sheet-metal shingles imitating the appearance of pantiles remained popular from the second half of the 19th century into the 20th century. (Episcopal Church, now the Jerome Historical Society Building, Jerome, Arizona, 1927)

aesthetic potential. Because slate was available in different colors (red, green, purple, and blue-gray), it was an effective material for decorative patterns on many 19th-century roofs (Gothic and Mansard styles). Slate continued to be used well into the 20th century, notably on many Tudor revival style buildings of the 1920s.

Shingles: Wood shingles were popular throughout the country in all periods of building history. The size and shape of the shingles as well as the detailing of the shingle roof differed according to regional craft practices. People within particular regions developed preferences for the local species of wood that most suited their purposes. In New England and the Delaware Valley, white pine was frequently used: in the South, cypress and oak; in the far west, red cedar or redwood. Sometimes a protective coating was applied to increase the durability of the shingle such as a mixture of brick dust and fish oil, or a paint made of red iron oxide and linseed oil.

Commonly in urban areas, wooden roofs were replaced with more fire resistant materials, but in rural areas this was not a major concern. On many Victorian country houses, the practice of wood shingling survived the technological advances of metal roofing in the 19th century, and near the turn of the century enjoyed a full revival in its namesake, the Shingle Style. Colonial revival and the Bungalow styles in the 20th century assured wood shingles a place as one of the most fashionable, domestic roofing materials.

Metal: Metal roofing in America is principally a 19th-century phenomenon. Before then the only metals commonly used were lead and copper. For example, a lead roof covered "Rosewell," one of the grandest mansions in 18th-century Virginia. But more often, lead was used for protective flashing. Lead, as well as copper, covered roof surfaces where wood, tile, or slate shingles were inappropriate because of the roof's pitch or shape.

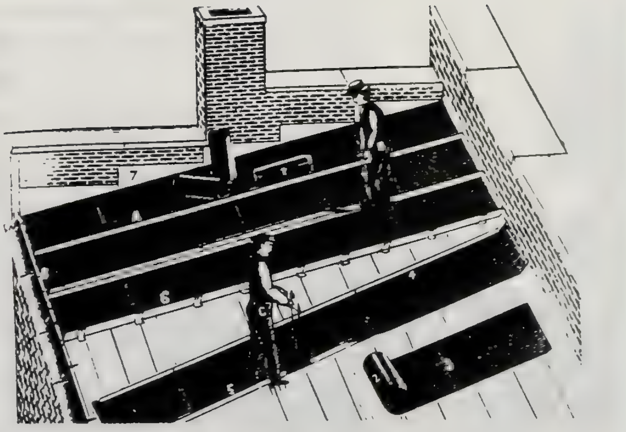
Copper with standing seams covered some of the more notable early American roofs including that of Christ Church (1727-1744) in Philadelphia. Flat-seamed copper was used on many domes and cupolas. The copper sheets were imported from England until the end of the 18th century when facilities for rolling sheet metal were developed in America.

Sheet iron was first known to have been manufactured here by the Revolutionary War financier, Robert Morris, who had a rolling mill near Trenton, New Jersey. At his mill Morris produced the roof of his own Philadelphia mansion, which he started in 1794. The architect Benjamin H. Latrobe used sheet iron to replace the roof on Princeton's "Nassau Hall," which had been gutted by fire in 1802.

The method for corrugating iron was originally patented in England in 1829. Corrugating stiffened the sheets, and allowed greater span over a lighter framework, as well as reduced installation time and labor. In 1834 the American architect William Strickland proposed corrugated iron to cover his design for the market place in Philadelphia.

Galvanizing with zinc to protect the base metal from rust was developed in France in 1837. By the 1850s the material was used on post offices and custom houses, as well as on train sheds and factories. In 1857 one of the first metal roofs in the

Repeated repair with asphalt, which cracks as it hardens, has created a blistered surface on this sheet-metal roof and built-in gutter, which will retain water. Repairs could be made by carefully heating and scraping the surface clean, repairing the holes in the metal with a flexible mastic compound or a metal patch, and coating the surface with a fibre paint. (Roane County Courthouse, Kingston, Tennessee, photo courtesy of Building Conservation Technology, Inc.)



A Chicago firm's catalog dated 1896 illustrates a method of unrolling, turning the edges, and finishing the standing seam on a metal roof.

Tin shingles, commonly embossed to imitate wood or tile, or with a decorative design, were popular as an inexpensive, textured roofing material. These shingles 8³/₈ inch by 12¹/₂ inch on the exposed surface) were designed with interlocking edges, but they have been repaired by surface nailing, which may cause future leakage. (Ballard House, Yorktown, Virgina, photo by Gordie Whittington, National Park Service)

South was installed on the U.S. Mint in New Orleans. The Mint was thereby "fireproofed" with a 20-gauge galvanized, corrugated iron roof on iron trusses.

Tin-plate iron, commonly called "tin roofing," was used extensively in Canada in the 18th century, but it was not as common in the United States until later. Thomas Jefferson was an early advocate of tin roofing, and he installed a standing-seam tin roof on "Monticello" (ca. 1770–1802). The Arch Street Meetinghouse (1804) in Philadelphia had tin shingles laid in a herringbone pattern on a "piazza" roof.

However, once rolling mills were established in this country, the low cost, light weight, and low maintenance of tin plate made it the most common roofing material. Embossed tin shingles, whose surfaces created interesting patterns, were popular throughout the country in the late 19th century. Tin roofs were kept well-painted, usually red; or, as the architect A. J. Davis suggested, in a color to imitate the green patina of copper.

Terne plate differed from tin plate in that the iron was dipped in an alloy of lead and tin, giving it a duller finish. Historic, as well as modern, documentation often confuses the two, so much that it is difficult to determine how often actual "terne" was used.

Zinc came into use in the 1820s, at the same time tin plate was becoming popular. Although a less expensive substitute for lead, its advantages were controversial, and it was never widely used in this country.

Other Materials: Asphalt shingles and roll roofing were used in the 1890s. Many roofs of asbestos, aluminum, stainless steel, galvinized steel, and lead-coated copper may soon have historic values as well. Awareness of these and other traditions of roofing materials and their detailing will contribute to more sensitive preservation treatments.

Locating the Problem

Failures of Surface Materials

When trouble occurs, it is important to contact a professional, either an architect, a reputable roofing contractor, or a craftsman familiar with the inherent characteristics of the particular historic roofing system involved. These professionals may be able to advise on immediate patching procedures and help plan more permanent repairs. A thorough examination of the roof should start with an appraisal of the existing condition and quality of the roofing material itself. Particular attention should be given to any southern slope because year-round exposure to direct sun may cause it to break down first.

Wood: Some historic roofing materials have limited life expectancies because of normal organic decay and "wear." For example, the flat surfaces of wood shingles erode from exposure to rain and ultraviolet rays. Some species are more hardy than others, and heartwood, for example, is stronger and more durable than sapwood.

Ideally, shingles are split with the grain perpendicular to

the surface. This is because if shingles are sawn across the grain, moisture may enter the grain and cause the wood to deteriorate. Prolonged moisture on or in the wood allows moss or fungi to grow, which will further hold the moisture and cause rot.

Metal: Of the inorganic roofing materials used on historic buildings, the most common are perhaps the sheet metals: lead, copper, zinc, tin plate, terne plate, and galvanized iron. In varying degrees each of these sheet metals are likely to deteriorate from chemical action by pitting or streaking. This can be caused by airborn pollutants; acid rainwater; acids from lichen or moss; alkalis found in lime mortars or portland cement, which might be on adjoining features and washes down on the roof surface; or tannic acids from adjacent wood sheathings or shingles made of red cedar or oak.

Corrosion from "galvanic action" occurs when dissimilar metals, such as copper and iron, are used in direct contact. Corrosion may also occur even though the metals are physically separated; one of the metals will react chemically against the other in the presence of an electrolyte such as rainwater. In roofing, this situation might occur when either a copper roof is decorated with iron cresting, or when steel nails are used in copper sheets. In some instances the corrosion can be prevented by inserting a plastic insulator between the dissimilar materials. Ideally, the fasteners should be a metal sympathetic to those involved.

Iron rusts unless it is well-painted or plated. Historically this problem was avoided by use of tin plating or galvinizing. But this method is durable only as long as the coating remains intact. Once the plating is worn or damaged, the exposed iron will rust. Therefore, any iron-based roofing material needs to be undercoated, and its surface needs to be kept well-painted to prevent corrosion.

One cause of sheet metal deterioration is fatigue. Depending upon the size and the gauge of the metal sheets, wear and metal failure can occur at the joints or at any protrusions in the sheathing as a result from the metal's alternating movement to thermal changes. Lead will tear because of "creep," or the gravitational stress that causes the material to move down the roof slope.

Slate: Perhaps the most durable roofing materials are slate and tile. Seemingly indestructable, both vary in quality. Some slates are hard and tough without being brittle. Soft slates are more subject to erosion and to attack by airborne and rainwater chemicals, which cause the slates to wear at nail holes, to delaminate, or to break. In winter, slate is very susceptible to breakage by ice, or ice dams.

Tile: Tiles will weather well, but tend to crack or break [illegible] as by tree branches, or if they are walked on improperly [illegible] slates, tiles cannot support much weight. Low quality tiles that have been insufficiently fired during manufacture, will craze and spall under the effects of freeze and thaw cycles [illegible] their porous surfaces.

Failures of Support Systems

Once the condition of the roofing material has been determined, the related features and support systems should be examined on the exterior and on the interior of the roof. The gutters and downspouts need periodic cleaning and maintenance since a variety of debris fill them, causing water to back up and seep under roofing units. Water will eventually cause fasteners, sheathing, and roofing structure to deteriorate. During winter, the daily freeze-thaw cycles can cause ice floes to develop under the roof surface. The pressure from these ice floes will dislodge the roofing material, especially slates, shingles, or tiles. Moreover, the buildup of ice dams above the gutters can trap enough moisture to rot the sheathing or the structural members.

Many large public buildings have built-in gutters set within the perimeter of the roof. The downspouts for these gutters may run within the walls of the building, or drainage may be through the roof surface or through a parapet to exterior downspouts. These systems can be effective if properly maintained; however, if the roof slope is inadequate for good runoff, or if the traps are allowed to clog, rainwater will form pools on the roof surface. Interior downspouts can collect debris and thus back up, perhaps leaking water into the surrounding walls. Exterior downspouts may fill with water, which in cold weather may freeze and crack the pipes. Conduits from the built-in gutter to the exterior downspout [illegible] also leak water into the surrounding roof structure or walls.

Failure of the flashing system is usually a major cause of roof deterioration. Flashing should be carefully inspected for failure caused by either poor workmanship, thermal stress, or metal deterioration (both of flashing material itself and of the fasteners). With many roofing materials, the replacement of flashing on an existing roof is a major operation, which may require taking up large sections of the roof surface. Therefore, the installation of top quality flashing material [illegible]

This detail shows slate delamination caused by a combination of weathering and pollution. In addition, the slates have eroded around the repair nails, incorrectly placed in the exposed surface of the slates (Lower Pontalba Building, New Orleans, photo courtesy of Building Conservation Technology, Inc.)

Temporary stabilization [illegible] plywood and building paper can [illegible] can be properly repaired or replaced. [illegible] Massachusetts)

These two views of the same house demonstrate how the use of a substitute material can drastically affect the overall character of a structure. The textural interest of the original tile roof was lost with the use of asphalt shingles. Recent preservation efforts are replacing the tile roof. (Frank House, Kearney, Nebraska, photo courtesy of the Nebraska State Historical Society, Lincoln, Nebraska)

a new or replaced roof should be a primary consideration. *Remember, some roofing and flashing materials are not compatible.*

Roof fasteners and clips should also be made of a material compatible with all other materials used, or coated to prevent rust. For example, the tannic acid in oak will corrode iron nails. Some roofs such as slate and sheet metals may fail if nailed too rigidly.

If the roof structure appears sound and nothing indicates recent movement, the area to be examined most closely is the roof substrate—the sheathing or the battens. The danger spots would be near the roof plates, under any exterior patches, at the intersections of the roof planes, or at vertical surfaces such as dormers. Water penetration, indicating a breach in the roofing surface or flashing, should be readily apparent, usually as a damp spot or stain. Probing with a small pen knife may reveal any rot which may indicate previously undetected damage to the roofing membrane. Insect infestation evident by small exit holes and frass (a sawdust-like debris) should also be noted. Condensation on the underside of the roofing is undesirable and indicates improper ventilation. Moisture will have an adverse effect on any roofing material; a good roof stays dry inside and out.

Repair or Replace

Understanding potential weaknesses of roofing material also requires knowledge of repair difficulties. Individual slates can be replaced normally without major disruption to the rest of the roof, but replacing flashing on a slate roof can require substantial removal of surrounding slates. If it is the substrate or a support material that has deteriorated, many surface materials such as slate or tile can be reused if handled carefully during the repair. Such problems should be evaluated at the outset of any project to determine if the roof can be effectively patched, or if it should be completely replaced.

Will the repairs be effective? Maintenance costs tend to multiply once trouble starts. As the cost of labor escalates, repeated repairs could soon equal the cost of a new roof.

The more durable the surface is initially, the easier it will be to maintain. Some roofing materials such as slate are expensive to install, but if top quality slate and flashing are used, it will last 40-60 years with minimal maintenance. Although the installation cost of the roof will be high, low maintenance needs will make the lifetime cost of the roof less expensive.

Historical Research

In a restoration project, research of documents and physical investigation of the building usually will establish the roof's history. Documentary research should include any original plans or building specifications, early insurance surveys, newspaper descriptions, or the personal papers and files of people who owned or were involved in the history of the building. Old photographs of the building might provide evidence of missing details.

Along with a thorough understanding of any written history of the building, a physical investigation of the roofing and its structure may reveal information about the roof's construction history. Starting with an overall impression of the structure, are there any changes in the roof slope, its configuration, or roofing materials? Perhaps there are obvious patches or changes in patterning of exterior brickwork where a gable roof was changed to a gambrel, or where a whole upper story was added. Perhaps there are obvious stylistic changes in the roof line, dormers, or ornamentation. These observations could help one understand any important alteration, and could help establish the direction of further investigation.

Because most roofs are physically out of the range of careful scrutiny, the "principle of least effort" has probably limited the extent and quality of previous patching or replacing, and usually considerable evidence of an earlier roof surface remains. Sometimes the older roof will be found as an underlayment of the current exposed roof. Original roofing may still be intact in awkward places under later features on a roof. Often if there is any unfinished attic space, remnants of roofing may have been dropped and left when the roof was being built or repaired. If the configuration of the roof has been changed, some of the original material might still be in place under the existing roof. Sometimes whole sections of the roof and roof framing will have been left intact under the higher roof. The profile and/or flashing of the earlier roof may be apparent on the interior of the walls at the level of the alteration. If the sheathing or lathing appears to have survived changes in the roofing surface, they may contain evidence of the roofing systems. These may appear either as dirt marks, which provide "shadows" of a roofing material, or as nails broken or driven down into the wood, rather than pulled out during previous alterations or repairs. Wooden headers in the roof framing may indicate that earlier chimneys or skylights have been removed. Any metal ornamentation that might have existed may be indicated by anchors or unusual markings along the ridge or at other edges of the roof. This primary

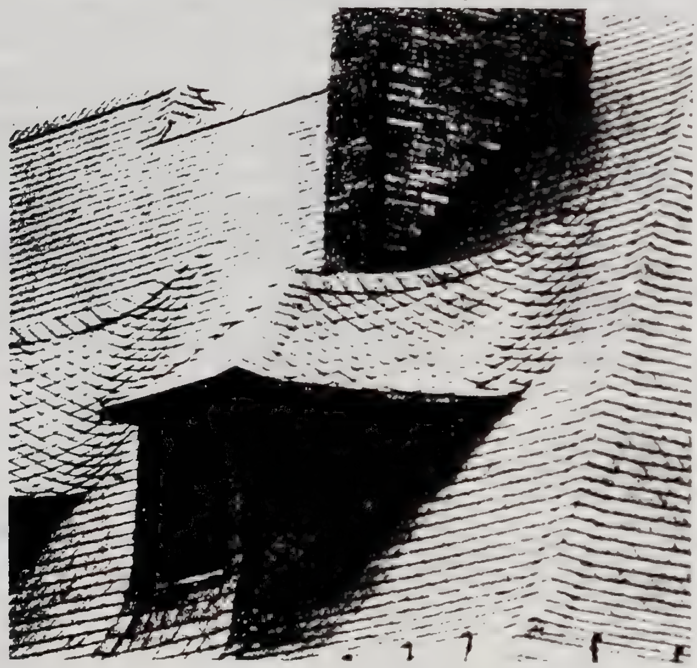
evidence is essential for a full understanding of the roof's history.

Caution should be taken in dating early "fabric" on the evidence of a single item, as recycling of materials is not a mid-20th-century innovation. Carpenters have been reusing materials, sheathing, and framing members in the interest of economy for centuries. Therefore, any analysis of the materials found, such as nails or sawmarks on the wood, requires an accurate knowledge of the history of local building practices before any final conclusion can be accurately reached. It is helpful to establish a sequence of construction history for the roof and roofing materials; any historic fabric or pertinent evidence in the roof should be photographed, measured, and recorded for future reference.

During the repair work, useful evidence might unexpectedly appear. It is essential that records be kept of any type of work on a historic building, before, during, and after the project. Photographs are generally the easiest and fastest method, and should include overall views and details at the gutters, flashing, dormers, chimneys, valleys, ridges, and eaves. All photographs should be immediately labeled to insure accurate identification at a later date. Any patterning or design on the roofing deserves particular attention. For example, slate roofs are often decorative and have subtle changes in size, color, and texture, such as a gradually decreasing coursing length from the eave to the peak. If not carefully noted before a project begins, there may be problems in replacing the surface. The standard reference for this phase of the work is *Recording Historic Buildings,* compiled by Harley J. McKee for the Historic American Buildings Survey, National Park Service, Washington, D.C., 1970.

Replacing the Historic Roofing Material

Professional advice will be needed to assess the various aspects of replacing a historic roof. With some exceptions, most historic roofing materials are available today. If not, an architect or preservation group who has previously worked with the same type material may be able to recommend suppliers. Special roofing materials, such as tile or embossed metal shingles, can be produced by manufacturers of related products that are commonly used elsewhere, either on the exterior or interior of a structure. With some creative thinking and research, the historic materials usually can be found.



Because of the roof's visibility, the slate detailing around the dormers is important to the character of this structure. Note how the slates swirl from a horizontal pattern on the main roof to a diamond pattern on the dormer roofs and side walls. (18th and Que Streets, NW, Washington, D.C.)

Craft Practices: Determining the craft practices used in the installation of a historic roof is another major concern in roof restoration. Early builders took great pride in their work, and experience has shown that the "rustic" or irregular designs commercially labled "Early American" are a 20th-century invention. For example, historically, wood shingles underwent several distinct operations in their manufacture including splitting by hand, and smoothing the surface with a draw knife. In modern nomenclature, the same item would be a "tapersplit" shingle which has been dressed. Unfortunately, the rustic appearance of today's commercially available "handsplit" and re-sawn shingle bears no resemblance to the hand-made roofing materials used on early American buildings.

Good design and quality materials for the roof surface, drainage and flashing minimize roofing failures. This is essential on roofs such as on the National Cathedral where a thorough maintenance inspection and minor repairs cannot be done easily without special scaffolding. However, the success of the roof on any structure depends on frequent cleaning and repair of the gutter system. (Washington, D.C.; photo courtesy of John Burns, A.I.A.)

Early craftsmen worked with a great deal of common sense; they understood their materials. For example they knew that wood shingles should be relatively narrow; shingles much wider than about 6" would split when walked on, or they may curl or crack from varying temperature and moisture. It is important to understand these aspects of craftsmanship, remembering that people wanted their roofs to be weathertight and to last a long time. The recent use of "[illegible]" shingles on historic structures is a gross underestimation of the early craftsman's skills.

Supervision: Finding a modern craftsman to reproduce historic details may take some effort. It may even involve some special instruction to raise his understanding of certain historic craft practices. At the same time, it may be pointless (and expensive) to follow historic craft practices in any construction that will not be visible on the finished product. But if the roofing details are readily visible, the appearance should be based on architectural evidence or on historic prototypes. For instance, the spacing of the seams on a standing-seam metal roof will affect the building's overall scale and should therefore match the original dimensions of the seams.

Many older roofing practices are no longer performed because of modern improvements. Research and review of specific detailing in the roof with the contractor before beginning the project is highly recommended. For example, one early craft practice was to finish the ridge of a wood shingle roof with a roof "comb"—that is, the top course of one slope of the roof was extended uniformly beyond the peak to shield the ridge, and to provide some weather protection for the raw horizontal edges of the shingles on the other slope. If the "comb" is known to have been the correct detail, it should be used. Though this method leaves the top course vulnerable to the weather, a disguised strip of flashing will strengthen this weak point.

Detail drawings or a sample mock-up will help ensure that the contractor or craftsman understands the scope and special requirements of the project. It should never be assumed that the modern carpenter, slater, sheet metal worker, or roofer will know all the historic details. Supervision is as important as any other stage of the process.

Special problems inherent in the design of an elaborate historic roof can be controlled through the use of good materials and regular maintenance. The shape and detailing are essential elements of the building's historic character, and should not be modified, despite the use of alternative surface materials. (Gamwell House, Bellingham, Washington)

Alternative Materials

The use of the historic roofing material on a structure may be restricted by building codes or by the availability of the materials, in which case an appropriate alternative will have to be found.

Some municipal building codes allow variances for roofing materials in historic districts. In other instances, individual variances may be obtained. Most modern heating and cooking is fueled by gas, electricity, or oil—none of which emit the hot embers that historically have been the cause of roof fires. Where wood burning fireplaces or stoves are used, spark arrestor screens at the top of the chimneys help to prevent flaming material from escaping, thus reducing the number of fires that start at the roof. In most states, insurance rates have been equalized to reflect revised considerations for the risks involved with various roofing materials.

In a rehabilitation project, there may be valid reasons for replacing the roof with a material other than the original. The historic roofing may no longer be available, or the cost of obtaining specially fabricated materials may be prohibitive. But the decision to use an alternative material should be weighed carefully against the primary concern to keep the historic character of the building. If the roof is flat and is not visible from any elevation of the building, and if there are advantages to substituting a modern built-up composition roof for what might have been a flat metal roof, then it may make better economic and construction sense to use a modern roofing method. But if the roof is readily visible, the alternative material should match as closely as possible the scale, texture, and coloration of the historic roofing material.

Asphalt shingles or ceramic tiles are common substitute materials intended to duplicate the appearance of wood shingles, slates, or tiles. Fire-retardant, treated wood shingles are currently available. The treated wood tends, however, to be brittle, and may require extra care (and expense) to install. In some instances, shingles laid with an interlay of fire-retardent building paper may be an acceptable alternative.

Lead-coated copper, terne-coated steel, and aluminum/zinc-coated steel can successfully replace tin, terne plate, zinc, or lead. Copper-coated steel is a less expensive (and less durable) substitute for sheet copper.

The search for alternative roofing materials is not new. As early as the 18th century, fear of fire cause many wood shingle or board roofs to be replaced by sheet metal or clay tile. Some historic roofs were failures from the start, based on overambitious and naive use of materials as they were first developed. Research on a structure may reveal that an inadequately designed or a highly combustible roof was replaced early in its history, and therefore restoration of a later roof material would have a valid precedent. In some cities, the substitution of sheet metal on early row houses occurred as soon as the rolled material became available.

Cost and ease of maintenance may dictate the substitution of a material wholly different in appearance from the original. The practical problems (wind, weather, and roof pitch) should be weighed against the historical consideration of scale, texture, and color. Sometimes the effect of the alternative material will be minimal. But on roofs with a high degree of visibility and patterning or texture, the substitution may seriously alter the architectural character of the building.

Temporary Stabilization

It may be necessary to carry out an immediate and temporary stabilization to prevent further deterioration until research can determine how the roof should be restored or rehabilitated, or until funding can be provided to do a proper job. A simple covering of exterior plywood or roll roofing might provide adequate protection, but any temporary covering should be applied with caution. One should be careful not to overload the roof structure, or to damage or destroy historic evidence or fabric that might be incorporated into a new roof at a later date. In this sense, repairs with caulking or bituminous patching compounds should be recognized as potentially harmful, since they are difficult to remove, and at their best, are very temporary.

Precautions

The architect or contractor should warn the owner of any precautions to be taken against the specific hazards in installing the roofing material. Soldering of sheet metals, for instance, can be a fire hazard, either from the open flame or from overheating and undected smoldering of the wooden substrate materials.

Thought should be given to the design and placement of any modern roof appurtenances such as plumbing stacks, air vents, or TV antennas. Consideration should begin with the placement of modern plumbing on the interior of the building, otherwise a series of vent stacks may pierce the roof membrane at various spots creating maintenance problems as well as aesthetic ones. Air handling units placed in the attic space will require vents which, in turn, require sensitive design. Incorporating these in unused chimneys has been very successful

in the past.

Whenever gutters and downspouts are needed that were not on the building historically, the additions should be made as unobtrusively as possible, perhaps by painting them out with a color compatible with the nearby wall or trim.

Maintenance

Although a new roof can be an object of beauty, it will not be protective for long without proper maintenance. At least twice a year, the roof should be inspected against a checklist. All changes should be recorded and reported. Guidelines should be established for any foot traffic that may be required for the maintenance of the roof. Many roofing materials should not be walked on at all. For some—slate, asbestos, and clay tile—a self-supporting ladder might be hung over the ridge of the roof, or planks might be spanned across the roof surface. Such items should be specifically designed and kept in a storage space accessible to the roof. If exterior work ever requires hanging scaffolding, use caution to insure that the anchors do not penetrate, break, or wear the roofing surface, gutters, or flashing.

Any roofing system should be recognized as a membrane that is designed to be self-sustaining, but that can be easily damaged by intrusions such as pedestrian traffic or fallen tree branches. Certain items should be checked at specific times. For example, gutters tend to accumulate leaves and debris during the spring and fall and after heavy rain. Hidden gutter screening both at downspouts and over the full length of the gutter could help keep them clean. The surface material would require checking after a storm as well. Periodic checking of the underside of the roof from the attic after a storm or winter freezing may give early warning of any leaks. Generally, damage from water or ice is less likely on a roof that has good flashing on the outside and is well ventilated and insulated on the inside. Specific instructions for the maintenance of the different roof materials should be available from the architect or contractor.

Summary

The essential ingredients for replacing and maintaining a historic roof are:

- Understanding the historic character of the building and being sympathetic to it.
- Careful examination and recording of the existing roof and any evidence of earlier roofs.
- Consideration of the historic craftsmanship and detailing and implementing them in the renewal wherever visible.
- Supervision of the roofers or maintenance personnel to assure preservation of historic fabric and proper understanding of the scope and detailing of the project.
- Consideration of alternative materials where the original cannot be used.
- Cyclical maintenance program to assure that the staff understands how to take care of the roof and of the particular trouble spots to safeguard.

With these points in mind, it will be possible to preserve the architectural character and maintain the physical integrity of the roofing on a historic building.

This Preservation Brief was written by Sarah M. Sweetser, Architectural Historian, Technical Preservation Services Division. Much of the technical information was based upon an unpublished report prepared under contract for this office by John G. and Diana S. Waite. Some of the historical information was from Charles E. Peterson, FAIA, "American Notes," *Journal of the Society of Architectural Historians.*

The illustrations for this brief not specifically credited are from the files of the Technical Preservation Services Division.

The publication has been prepared pursuant to Executive Order 11593, "Protection and Enhancement of the Cultural Environment," which directs the Secretary of the Interior to ". . . develop and make available to Federal agencies and State and local governments information concerning professional methods and [illegible] preserving, improving, restoring and maintaining [illegible] properties." This brief was developed under the [illegible] H. Nelson, AIA, Technical Preservation Services [illegible] Archeology and Historic Preservation, Heritage [illegible] Recreation Service, U.S. Department of the Interior, [illegible] D.C. 20240. February 1978

Decorative features such as cupolas require extra [illegible]. The flashing is carefully detailed to promote run-off, and the [illegible] ing must be kept well-painted. This roof surface, [illegible] tin plate, has been replaced with lead-coated copper [illegible] purposes. (Lyndhurst, Tarrytown, New York [illegible] National Trust for Historic Preservation)

Additional readings on the subject of roofing are [illegible]

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Exhibit II

EXHIBIT II.

PRESERVATION BRIEF #13:
THE REPAIR AND THERMAL UPGRADING OF
HISTORIC STEEL WINDOWS

SHARON C. PARK, AIA
1981

13 PRESERVATION BRIEFS

The Repair and Thermal Upgrading of Historic Steel Windows

Sharon C. Park, AIA

Technical Preservation Services   Preservation Assistance Division
National Park Service   U.S. Department of the Interior

> The Secretary of the Interior's "Standards for Rehabilitation" require that where historic windows are individually significant features, or where they contribute to the character of significant facades, their distinguishing visual qualities must not be destroyed. Further, the rehabilitation guidelines recommend against changing the historic appearance of windows through the use of inappropriate designs, materials, finishes, or colors which radically change the sash, depth of reveal, and muntin configuration; the reflectivity and color of the glazing; or the appearance of the frame.

Windows are among the most vulnerable features of historic buildings undergoing rehabilitation. This is especially the case with rolled steel windows, which are often mistakenly not deemed worthy of preservation in the [illegible] of old buildings to new uses. The ease with which they can be replaced and the mistaken assumption that they cannot be made energy efficient except at great expense are factors that typically lead to the decision to remove them. In many cases, however, repair and retrofit of the historic windows are more economical than wholesale replacement, and all too often, replacement units are unlike the originals in design and appearance. If the windows are important in establishing the historic character of the building (see fig. 1), insensitively designed replacement windows may diminish—or destroy—the building's historic character.

This *Brief* identifies various types of historic steel windows that dominated the metal window market from 1890-1950. It then gives criteria for evaluating deterioration and for determining appropriate treatment, ranging from routine maintenance and weatherization to extensive repairs, so that replacement may be avoided where possible.[1] This information applies to do-it-yourself jobs and to large rehabilitations where the volume of work warrants the removal of all window units for complete overhaul by professional contractors.

This *Brief* is not intended to promote the repair of ferrous metal windows in every case, but rather to insure that preservation is always the first consideration in a rehabilitation project. Some windows are not important [illegible] defining a building's historic character; others [illegible] significant, but so deteriorated that repair is infeasible. In such cases, the *Brief* offers guidance in evaluating appropriate replacement windows.

Fig. 1 Often highly distinctive in design and craftsmanship, rolled steel windows play an important role in defining the architectural character of many later nineteenth and early twentieth century buildings. Art Deco, Art Moderne, the International Style, and Post World War II Modernism depended on the slim profiles and streamlined appearance of metal windows for much of their impact. Photo: William G. Johnson.

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[1] The technical information given in this brief is intended for most ferrous (or magnetic) metals, particularly rolled steel. While stainless steel is a ferrous metal, the cleaning and repair techniques outlined here must not be used on it as the finish will be damaged. For information on cleaning stainless steel and non-ferrous metals, such as bronze, Monel, or aluminum, refer to *Metals in America's Historic Buildings* (see bibliography).

HISTORICAL DEVELOPMENT

Although metal windows were available as early as 1860 from catalogues published by architectural supply firms, they did not become popular until after 1890. Two factors combined to account for the shift from wooden to metal windows about that time. Technology borrowed from the rolling industry permitted the mass production of rolled steel windows. This technology made metal windows cost competitive with conventional wooden windows. In addition, a series of devastating urban fires in Boston, Baltimore, Philadelphia, and San Francisco led to the enactment of strict fire codes for industrial and multistory commercial and office buildings.

As in the process of making rails for railroads, rolled steel windows were made by passing hot bars of steel through progressively smaller, shaped rollers until the appropriate angled configuration was achieved (see fig. 2). The rolled steel sections, generally 1/8" thick and 1" - 1 1/2" wide, were used for all the components of the windows: sash, frame,and subframe (see fig. 3). With the addition of wire glass, a fire-resistant window resulted. These rolled steel windows are almost exclusively found in masonry or concrete buildings.

A byproduct of the fire-resistant window was the strong metal frame that permitted the installation of larger windows and windows in series. The ability to have expansive amounts of glass and increased ventilation dramatically changed the designs of late 19th and early 20th century industrial and commercial buildings.

The newly available, reasonably priced steel windows soon became popular for more than just their fire-resistant qualities. They were standardized, extremely durable, and easily transported. These qualities led to the use of steel windows in every type of construction, from simple industrial and institutional buildings to luxury commercial and apartment buildings. Casement, double-hung, pivot, projecting, austral, and continuous windows differed in operating and ventilating capacities. Figure 4 outlines the kinds and properties of metal windows available then and now. In addition, the thin profiles of metal windows contributed to the streamlined appearance of the Art Deco, Art Moderne, and International Styles, among others.

The extensive use of rolled steel metal windows continued until after World War II when cheaper, non-corroding aluminum windows became increasingly popular. While aluminum windows dominate the market today, steel windows are still fabricated. Should replacement of original windows become necessary, replacement windows may be available from the manufacturers of some of the earliest steel windows. Before an informed decision can be made whether to repair or replace metal windows, however, the significance of the windows must be determined and their physical condition assessed.

Cover illustration: from *Hope's Metal Windows and Casements: 1818-1926*, currently Hope's Architectural Products, Inc. Used with permission.

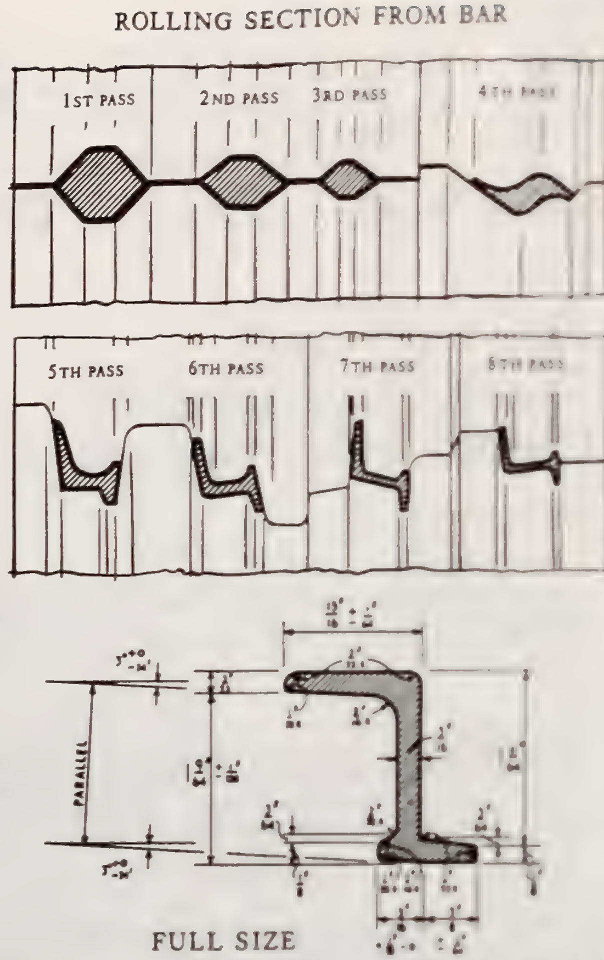


Fig. 2. The process of rolling a steel bar into an angled [illegible] *lustrated above. The shape and size* [illegible] *ly depending on the overall strength needed for the* [illegible] *the location of the section in the assemb*[illegible] *The 1/8 " thickness of the metal section* [illegible] *A Metal Window Dictionary. Used with perm*[illegible]

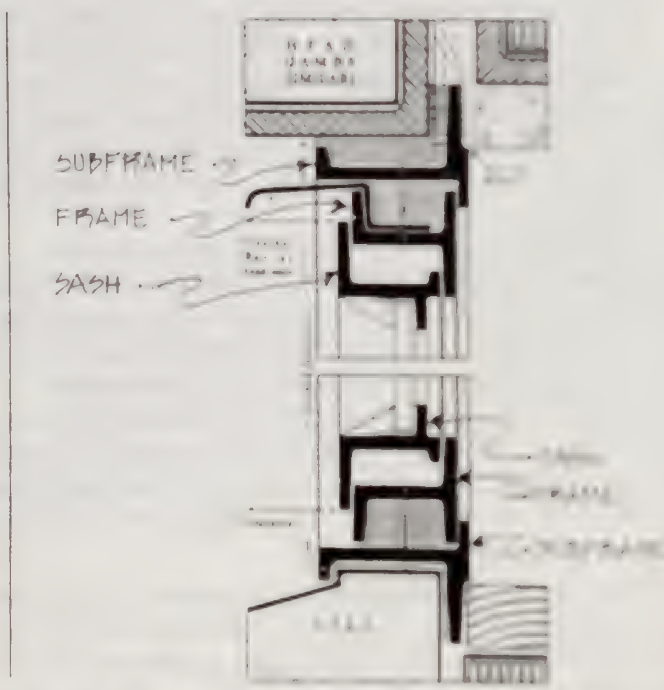


Fig. 3 A typical section through the [illegible] *shows the three component parts of the* [illegible] *frame, and sash. Drawings: Catalogue* [illegible] *tional Casement Co. Inc., presently* [illegible] *Jamestown, NY. Used with permi*[illegible]

EVALUATION

Historic and Architectural Considerations

:nent of the significance of the windows should egin with a consideration of their function in relation to he building's historic use and its historic character. Win- lows that help define the building's historic character hould be preserved even if the building is being converted ɔ a new use. For example, projecting steel windows used ɔ introduce light and an effect of spaciousness to a 'arehouse or industrial plant can be retained in the con- ersion of such a building to offices or residences.

Other elements in assessing the relative importance of ıe historic windows include the design of the windows nd their relationship to the scale, proportion, detailing nd architectural style of the building. While it may be ısy to determine the aesthetic value of highly ornamented indows, or to recognize the importance of streamlined indows as an element of a style, less elaborate windows ın also provide strong visual interest by their small panes r projecting planes when open, particularly in simple, ıadorned industrial buildings (see fig. 5).

One test of the importance of windows to a building is ask if the overall appearance of the building would be ıanged noticeably if the windows were to be removed or dically altered. If so, the windows are important in :fining the building's historic character, and should be paired if their physical condition permits.

hysical Evaluation

:eel window repair should begin with a careful evaluation the physical condition of each unit. Either drawings or ıotographs, liberally annotated, may be used to record e location of each window, the type of operability, the ındition of all three parts—sash, frame and sub- ame—and the repairs essential to its continued use.

Specifically, the evaluation should include: presence and gree of corrosion; condition of paint; deterioration of e metal sections, including bowing, misalignment of the sh, or bent sections; condition of the glass and glazing mpound; presence and condition of all hardware, 'ews, bolts, and hinges; and condition of the masonry concrete surrounds, including need for caulking or ;etting of improperly sloped sills.

Corrosion, principally rusting in the case of steel win- ws, is the controlling factor in window repair; :refore, the evaluator should first test for its presence. rrosion can be light, medium, or heavy, depending on w much the rust has penetrated the metal sections. If rusting is merely a surface accumulation or flaking, n the corrosion is light. If the rusting has penetrated metal (indicated by a bubbling texture), but has not ısed any structural damage, then the corrosion is he rust has penetrated deep into the metal, ı is heavy. Heavy corrosion generally results ;ome form of structural damage,through delamination, to the metal section, which must then be patched or spliced. A sharp probe or tool, such as an ice pick, can be used to determine the extent of corrosion in the metal. If the probe can penetrate the surface of the metal and brittle strands can be dug out, then a high degree of corrosive deterioration is present.

In addition to corrosion, the condition of the paint, the presence of bowing or misalignment of metal sections, the amount of glass needing replacement, and the condition of the masonry or concrete surrounds must be assessed in the evaluation process. These are key factors in determining whether or not the windows can be repaired in place. The more complete the inventory of existing conditions, the easier it will be to determine whether repair is feasible or whether replacement is warranted.

Rehabilitation Work Plan

Following inspection and analysis, a plan for the rehabilitation can be formulated. The actions necessary to return windows to an efficient and effective working condition will fall into one or more of the following categories: routine maintenance, repair, and weatherization. The routine maintenance and weatherization measures described here are generally within the range of do-it-yourselfers. Other repairs, both moderate and major, require a professional contractor. Major repairs normally require the removal of the window units to a workshop, but even in the case of moderate repairs, the number of windows involved might warrant the removal of all the deteriorated units to a workshop in order to realize a more economical repair price. Replacement of windows should be considered only as a last resort.

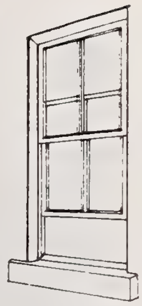
Since moisture is the primary cause of corrosion in steel windows, it is essential that excess moisture be eliminated and that the building be made as weathertight as possible before any other work is undertaken. Moisture can accumulate from cracks in the masonry, from spalling mortar, from leaking gutters, from air conditioning condensation runoff, and from poorly ventilated interior spaces.

Finally, before beginning any work, it is important to be aware of health and safety risks involved. Steel windows have historically been coated with lead paint. The removal of such paint by abrasive methods will produce toxic dust. Therefore, safety goggles, a toxic dust respirator, and protective clothing should be worn. Similar protective measures should be taken when acid compounds are used. Local codes may govern the methods of removing lead paints and proper disposal of toxic residue.

ROUTINE MAINTENANCE

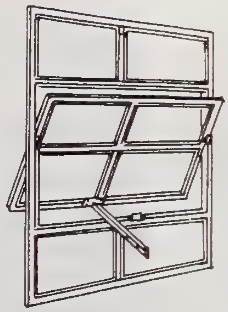
A preliminary step in the routine maintenance of steel windows is to remove surface dirt and grease in order to ascertain the degree of deterioration, if any. Such minor cleaning can be accomplished using a brush or vacuum followed by wiping with a cloth dampened with mineral spirits or denatured alcohol.

Double-hung industrial windows duplicated the look of traditional wooden windows. Metal double-hung windows were early examples of a building product adapted to meet stringent new fire code requirements for manufacturing and high-rise buildings in urban areas. Soon supplanted in industrial buildings by less expensive pivot windows, double-hung metal windows regained popularity in the 1940s for use in speculative suburban housing.



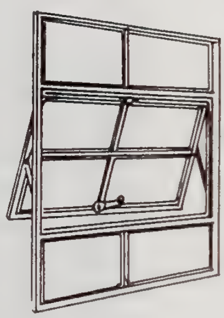
Austral windows were also a product of the 1920s. They combined the appearance of the double-hung window with the increased ventilation and ease of operation of the projected window. (When fully opened, they provided 70% ventilation as compared to 50% ventilation for double-hung windows.) Austral windows were often used in schools, libraries and other public buildings.

Pivot windows were an early type of industrial window that combined inexpensive first cost and low maintenance. Pivot windows became standard for warehouses and power plants where the lack of screens was not a problem. The window shown here is a horizontal pivot. Windows that turned about a vertical axis were also manufactured (often of iron). Such vertical pivots are rare today.



Casement windows adapted the English tradition of using wrought iron casements with leaded cames for residential use. Rolled steel casements (either single, as shown, or paired) were popular in the 1920s for cottage style residences and Gothic style campus architecture. More streamlined casements were popular in the 1930s for institutional and small industrial buildings.

Projecting windows, sometimes called awning or hopper windows, were perfected in the 1920s for industrial and institutional buildings. They were often used in "combination" windows, in which upper panels opened out and lower panels opened in. Since each movable panel projected to one side of the frame only, unlike pivot windows, for example, screens could be introduced.



Continuous windows were almost exclusively used for industrial buildings requiring high overhead lighting. Long runs of clerestory windows operated by mechanical tension rod gears were typical. Long banks of continuous windows were possible because the frames for such windows were often structural elements of the building.

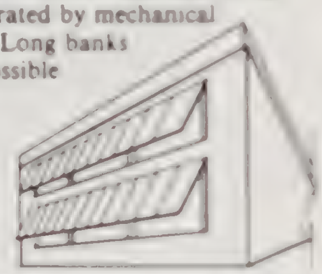


Fig. 4 Typical rolled steel windows available from 1890 to the present. The various operating and ventilating capacities in combination with the aesthetics of the window style were important considerations in the selection of one window type over another. Drawings: Sharon C. Park, AIA.

If it is determined that the windows are in basically sound condition, the following steps can be taken: 1) removal of light rust, flaking and excessive paint; 2) priming of exposed metal with a rust-inhibiting primer; 3) replacement of cracked or broken glass and glazing compound; 4) replacement of missing screws or fasteners; 5) cleaning and lubrication of hinges; 6) repainting of all steel sections with two coats of finish paint compatible with the primer; and 7) caulking the masonry surrounds with a high quality elastomeric caulk.

Recommended methods for removing light rust include manual and mechanical abrasion or the application of chemicals. Burning off rust with an oxy-acetylene or propane torch, or an inert gas welding gun, should never be attempted because the heat can distort the metal. In addition, such intense heat (often as high as 3800° F) vaporizes the lead in old paint, resulting in highly toxic fumes. Furthermore, such heat will likely result in broken glass. Rust can best be removed using a wire brush, an aluminum oxide sandpaper, or a variety of power tools

Fig. 5 Windows often provide a strong visual element in relatively simple or unadorned industrial or commercial buildings. This design element should be taken into consideration when evaluating the significance of the windows. Photo: Michael Auer

adapted for abrasive cleaning such as an electric drill with a wire brush or a rotary whip attachment. Adjacent sills ınd window jambs may need protective shielding.

Rust can also be removed from ferrous metals by using ›f commercially prepared anti-corrosive acid ...s. Effective on light and medium corrosion, ıese compounds can be purchased either as liquids or ɜls. Several bases are available, including phosphoric :id, ammonium citrate, oxalic acid and hydrochloric :id. Hydrochloric acid is generally not recommended; it ın leave chloride deposits, which cause future corrosion. hosphoric acid-based compounds do not leave such ɜposits, and are therefore safer for steel windows. owever, any chemical residue should be wiped off with ımp cloths, then dried immediately. Industrial blow-ɣers work well for thorough drying. The use of running ater to remove chemical residue is never recommended ɜcause the water may spread the chemicals to adjacent .rfaces, and drying of these surfaces may be more dif-:ult. Acid cleaning compounds will stain masonry; erefore plastic sheets should be taped to the edge of the etal sections to protect the masonry surrounds. The me measure should be followed to protect the glazing om etching because of acid contact.

Measures that remove rust will ordinarily remove flak-g paint as well. Remaining loose or flaking paint can be moved with a chemical paint remover or with a ıeumatic needle scaler or gun, which comes with a series chisel blades and has proven effective in removing flak-ɡ paint from metal windows. Well-bonded paint may ɾve to protect the metal further from corrosion, and removed unless paint build-up prevents the ndow from closing tightly. The edges should be feath-ed by sanding to give a good surface for repainting.

Next, any *bare* metal should be wiped with a cleaning lvent such as denatured alcohol, and dried immediately preparation for the application of an anti-corrosive imer. Since corrosion can recur very soon after metal s been exposed to the air, the metal should be primed mediately after cleaning. Spot priming may be required riodically as other repairs are undertaken. Anti-rrosive primers generally consist of oil-alkyd based ints rich in zinc or zinc chromate.[2] Red lead is no ıger available because of its toxicity. All metal primers, wever, are toxic to some degree and should be handled ·efully. Two coats of primer are recommended. Manu-:turer's recommendations should be followed concern-; application of primers.

:PAIR

ɔair in Place

ɜ maintenance procedures described above will be in- when corrosion is extensive, or when metal win- are misaligned. Medium to heavy corrosion t has not done any structural damage to the metal sec-ıs can be removed either by using the chemical cleaning process described under "Routine Maintenance" or by sandblasting. Since sandblasting can damage the masonry surrounds and crack or cloud the glass, metal or plywood shields should be used to protect these materials. The sandblasting pressure should be low, 80-100 pounds per square inch, and the grit size should be in the range of #10-#45. Glass peening beads (glass pellets) have also been successfully used in cleaning steel sections. While sand-blasting equipment comes with various nozzle sizes, pencil-point blasters are most useful because they give the operator more effective control over the direction of the spray. The small aperture of the pencil-point blaster is also useful in removing dried putty from the metal sec-tions that hold the glass. As with any cleaning technique, once the bare metal is exposed to air, it should be primed as soon as possible. This includes the inside rabbeted sec-tion of sash where glazing putty has been removed. To re-duce the dust, some local codes allow only wet blasting. In this case, the metal must be dried immediately, general-ly with a blow-drier (a step that the owner should consider when calculating the time and expense involved). Either form of sandblasting metal covered with lead paints pro-duces toxic dust. Proper precautionary measures should be taken against toxic dust and silica particles.

Bent or bowed metal sections may be the result of damage to the window through an impact or corrosive ex-pansion. If the distortion is not too great, it is possible to realign the metal sections without removing the window to a metal fabricator's shop. The glazing is generally remov-ed and pressure is applied to the bent or bowed section. In the case of a muntin, a protective 2 x 4 wooden brac-ing can be placed behind the bent portion and a wire cable with a winch can apply progressively more pressure over several days until the section is realigned. The 2 x 4 bracing is necessary to distribute the pressure evenly over the damaged section. Sometimes a section, such as the bottom of the frame, will bow out as a result of pressure exerted by corrosion and it is often necessary to cut the metal section to relieve this pressure prior to pressing the section back into shape and making a welded repair.

Once the metal sections have been cleaned of all corro-sion and straightened, small holes and uneven areas resulting from rusting should be filled with a patching material and sanded smooth to eliminate pockets where water can accumulate. A patching material of steel fibers and an epoxy binder may be the easiest to apply. This steel-based epoxy is available for industrial steel repair; it can also be found in auto body patching compounds or in plumber's epoxy. As with any product, it is important to follow the manufacturer's instructions for proper use and best results. The traditional patching technique—melting steel welding rods to fill holes in the metal sections—may be difficult to apply in some situations; moreover, the window glass must be removed during the repair process, or it will crack from the expansion of the heated metal sections. After these repairs, glass replacement, hinge lubrication, painting, and other cosmetic repairs can be undertaken as necessary.

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[2] Refer to Table IV. Types of Paint Used for Painting Metal in *Metals in America's Historic Buildings*, p. 139. (See bibliography).

To complete the checklist for routine maintenance, cracked glass, deteriorated glazing compound, missing screws, and broken fasteners will have to be replaced; hinges cleaned and lubricated; the metal windows painted, and the masonry surrounds caulked. If the glazing must be replaced, all clips, glazing beads, and other fasteners that hold the glass to the sash should be retained, if possible, although replacements for these parts are still being fabricated. When bedding glass, use only glazing compound formulated for metal windows. To clean the hinges (generally brass or bronze), a cleaning solvent and fine bronze wool should be used. The hinges should then be lubricated with a non-greasy lubricant specially formulated for metals and with an anti-corrosive agent. These lubricants are available in a spray form and should be used periodically on frequently opened windows.

Final painting of the windows with a paint compatible with the anti-corrosive primer should proceed on a dry day. (Paint and primer from the same manufacturer should be used.) Two coats of finish paint are recommended if the sections have been cleaned to bare metal. The paint should overlap the glass slightly to insure weathertightness at that connection. Once the paint dries thoroughly, a flexible exterior caulk can be applied to eliminate air and moisture infiltration where the window and the surrounding masonry meet.

Caulking is generally undertaken after the windows have received at least one coat of finish paint. The perimeter of the masonry surround should be caulked with a flexible elastomeric compound that will adhere well to both metal and masonry. The caulking used should be a type intended for exterior application, have a high tolerance for material movement, be resistant to ultraviolet light, and have a minimum durability of 10 years. Three effective compounds (taking price and other factors into consideration) are polyurethane, vinyl acrylic, and butyl rubber. In selecting a caulking material for a window retrofit, it is important to remember that the caulking compound may be covering other materials in a substrate. In this case, some compounds, such as silicone, may not adhere well. Almost all modern caulking compounds can be painted after curing completely. Many come in a range of colors, which eliminates the need to paint. If colored caulking is used, the windows should have been given two coats of finish paint prior to caulking.

Repair in Workshop

Damage to windows may be so severe that the window sash and sometimes the frame must be removed for cleaning and extensive rust removal, straightening of bent sections, welding or splicing in of new sections, and reglazing. These major and expensive repairs are reserved for highly significant windows that cannot be replaced; the procedures involved should be carried out only by skilled workmen. (see fig. 6a—6f.)

As part of the orderly removal of windows, each window should be numbered and the parts labelled. The operable metal sash should be dismantled by removing the hinges; the fixed sash and, if necessary, the frame can then be unbolted or unscrewed. (The subframe is usually left in place. Built into the masonry surrounds, it can be cut out with a torch.) Hardware and hinges should be labelled and stored together.

The two major choices for removing flaking paint and corrosion from severely deteriorated windows are dipping in a chemical bath or sandblasting. Both treatments require removal of the glass. If the windows are to be dipped, a phosphoric acid solution is preferred, as mentioned earlier. While the dip tank method is good for fairly evenly distributed rust, deep set rust may remain after dipping. For that reason, sandblasting is more effective for heavy and uneven corrosion. Both methods leave the metal sections clean of residual paint. As already noted, after cleaning has exposed the metal to the air, it should be primed immediately after drying with an anti-corrosive primer to prevent rust from recurring.

Sections that are seriously bent or bowed must be straightened with heat and applied pressure in a workshop. Structurally weakened sections must be cut out, generally with an oxy-acetylene torch, and replaced with sections welded in place and the welds ground smooth. Finding replacement metal sections, however, may be difficult. While most rolling mills are producing modern sections suitable for total replacement, it may be difficult to find an exact profile match for a splicing repair. The best source of rolled metal sections is from salvaged windows, preferably from the same building. If no salvaged windows are available, two options remain. Either an ornamental metal fabricator can weld flat plates into a built-up section, or a steel plant can mill bar steel into the desired profile.

While the sash and frame are removed for repair, the subframe and masonry surrounds should be inspected. This is also the time to reset sills or to remove corrosion from the subframe, taking care to protect the masonry surrounds from damage.

Missing or broken hardware and hinges should be replaced on all windows that will be operable. Salvaged windows, again, are the best source of replacement parts. If matching parts cannot be found, it may be possible to adapt ready-made items. Such a substitution may require filling existing holes with steel epoxy or with plug welds and tapping in new screw holes. However, if the hardware is a highly significant element of the historic window, it may be worth having reproductions made.

Following are illustrations of the repair and thermal upgrading of the rolled steel windows in a National Historic Landmark (fig. 6). Many of the techniques described above were used during this extensive rehabilitation. The complete range of repair techniques is then summarized in the chart titled *Steps for Cleaning and Repairing Historic Steel Windows* (see fig. 7).

Fig. 6 a. View of the flanking wing of the State Capitol where the rolled steel casement windows are being removed for repair.

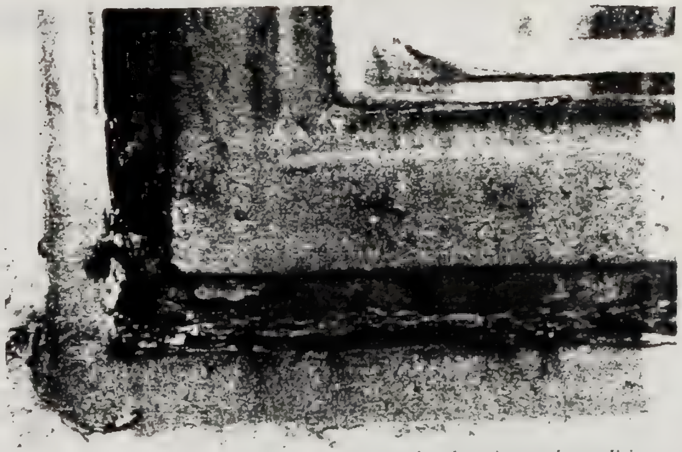

Fig. 6 b. View from the exterior showing the deteriorated condition of the lower corner of a window prior to repair. While the sash was in relatively good condition, the frame behind was rusted to the point of inhibiting operation.

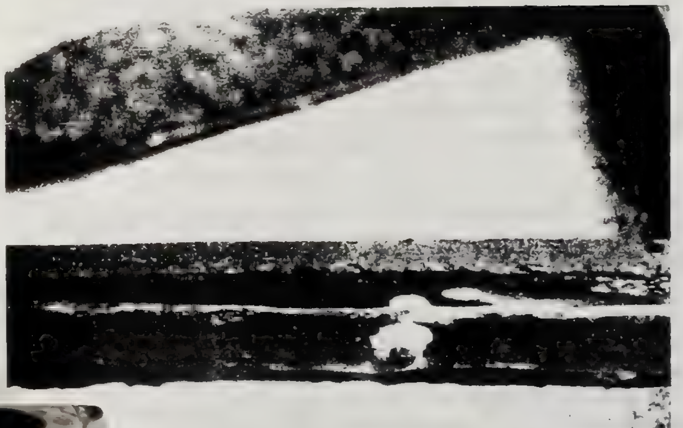

Fig. 6 c. View of the rusted frame which was unscrewed from the subframe and removed from the window opening and taken to a workshop for sandblasting. In some cases, severely deteriorated sections of the frame were replaced with new sections of milled bar steel.

Fig. 6 d. View looking down towards the sill. The subframes appeared very rusted, but were in good condition once debris was vacuumed and surface rust was removed, in place, with chemical compounds. Where necessary, epoxy and steel filler was used to patch depressions in order to make the subframe serviceable again.

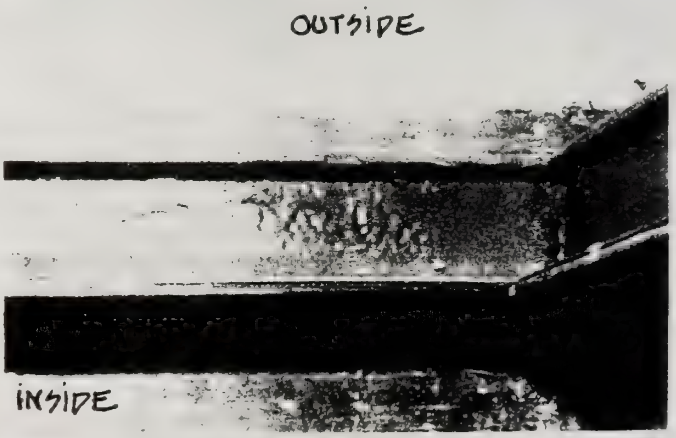

Fig. 6 e. View looking down towards the sill. The cleaned frame was reset in the window opening. The frame was screwed to the refurbished subframe at the jamb and the head only. The screw holes at the sill, which had been the cause of much of the earlier rusting, were infilled. Vinyl weatherstripping was added to the frame.

Fig. 6 f. View from the outside of the completely refurbished window. In addition to the steel repair and the installation of vinyl weatherstripping, the exterior was caulked with polyurethane and the single glass was replaced with individual lights of thermal glass. The repaired and upgraded windows have comparable energy efficiency ratings to new replacement units while retaining the historic steel sash, frames and subframes.

pair and thermal upgrading of the historic steel windows at the State Capitol, Lincoln, Nebraska. This early twentieth century building, designed by Bertram Goodhue, is a National Historic Landmark. Photos: All photos in this series were provided by the State Building Division.

STEPS FOR CLEANING AND REPAIRING HISTORIC STEEL WINDOWS

Work Item	Recommended Techniques	Tools, Products and Procedures	Notes
	*(Must be done in a workshop)		
1. Removing dirt and grease from metal	General maintenance and chemical cleaning	Vacuum and bristle brushes to remove dust and dirt; solvents (denatured alcohol, mineral spirits), and clean cloths to remove grease.	Solvents can cause eye and skin irritation. Operator should wear protective gear and work in ventilated area. Solvents should not contact masonry. Do not flush with water.
2. Removing Rust/ Corrosion			
Light	Manual and mechanical abrasion	Wire brushes, steel wool, rotary attachments to electric drill, sanding blocks and disks.	Handsanding will probably be necessary for corners. Safety goggles and masks should be worn.
	Chemical cleaning	Anti-corrosive jellies and liquids (phosphoric acid preferred); clean damp cloths.	Protect glass and metal with plastic sheets attached with tape. Do not flush with water. Work in ventilated area.
Medium	Sandblasting/abrasive cleaning	Low pressure (80-100 psi) and small grit (#10-#45); glass peening beads. Pencil blaster gives good control.	Removes both paint and rust. Codes should be checked for environmental compliance. Prime exposed metal promptly. Shield glass and masonry. Operator should wear safety gear.
Heavy	*Chemical dip tank	Metal sections dipped into chemical tank (phosphoric acid preferred) from several hours to 24 hours.	Glass and hardware should be removed. Protect operator. Deepest rust may remain, but paint will be removed.
	*Sandblasting/ abrasive cleaning	Low pressure (80-100 psi) and small grit (#10-#45).	Excellent for heavy rust. Remove or protect glass. Prime exposed metal promptly. Check codes for environmental compliance. Operator should wear safety gear.
3. Removing flaking paint.	Chemical method	Chemical paint strippers suitable for ferrous metals. Clean cloths.	Protect glass and masonry. Do not flush with water. Have good ventilation and protection for operator.
	Mechanical abrasion	Pneumatic needle gun chisels, sanding disks.	Protect operator; have good ventilation. Well-bonded paint need not be removed if window closes properly.
4. Aligning bent, bowed metal sections	Applied pressure	Wooden frame as a brace for cables and winch mechanism.	Remove glass in affected area. Realignment may take several days.
	*Heat and pressure	Remove to a workshop. Apply heat and pressure to bend back.	Care should be taken that heat does not deform slender sections.

Work Item	Recommended Techniques	Tools, Products and Procedures	Notes
	*(Must be done in a workshop)		
5. Patching depressions	Epoxy and steel filler	Epoxy fillers with high content of steel fibers; plumber's epoxy or autobody patching compound.	Epoxy patches generally are easy to apply, and can be sanded smooth. Patches should be primed.
	Welded patches	Weld in patches using steel rods and oxy-acetylene torch or arc welder.	Prime welded sections after grinding connections smooth.
6. Splicing in new metal sections	*Cut out decayed sections and weld in new or salvaged sections	Torch to cut out bad sections back to 45° joint. Weld in new pieces and grind smooth.	Prime welded sections after grinding connection smooth.
7. Priming metal sections	Brush or spray application	At least one coat of anti-corrosive primer on bare metal. Zinc-rich primers are generally recommended.	Metal should be primed as soon as it is exposed. If cleaned metal will be repaired another day, spot prime to protect exposed metal.
8. Replacing missing screws and bolts	Routine maintenance	Pliers to pull out or shear off rusted heads. Replace screws and bolts with similar ones, readily available.	If new holes have to be tapped into the metal sections, the rusted holes should be cleaned, filled and primed prior to redrilling.
lubricating or replacing hinges and other hardware	Routine maintenance, solvent cleaning	Most hinges and closure hardware are bronze. Use solvents (mineral spirits), bronze wool and clean cloths. Spray with non-greasy lubricant containing anti-corrosive agent.	Replacement hinges and fasteners may not match the original exactly. If new holes are necessary, old ones should be filled.
0. Replacing glass and glazing compound	Standard method for application	Pliers and chisels to remove old glass, scrape putty out of glazing rabbet, save all clips and beads for reuse. Use only glazing compound formulated for metal windows.	Heavy gloves and other protective gear needed for the operator. All parts saved should be cleaned prior to reinstallation.
1. Caulking masonry surrounds	Standard method for application	Good quality (10 year or better) elastomeric caulking compound suitable for metal.	The gap between the metal frame and the masonry opening should be caulked; keep weepholes in metal for condensation run-off clear of caulk.
2. Repainting metal windows	Spray or brush	At least 2 coats of paint compatible with the anti-corrosive primer. Paint should lap the glass about 1/8″ to form a seal over the glazing compound.	The final coats of paint and the primer should be from the same manufacturer to ensure compatibility. If spraying is used, the glass and masonry should be protected.

Fig. 7. STEPS FOR CLEANING AND REPAIRING HISTORIC STEEL WINDOWS. Compiled by Sharon C. Park, AIA.

WEATHERIZATION

Historic metal windows are generally not energy efficient; this has often led to their wholesale replacement. Metal windows can, however, be made more energy efficient in several ways, varying in complexity and cost. Caulking around the masonry openings and adding weatherstripping, for example, can be do-it-yourself projects and are important first steps in reducing air infiltration around the windows. They usually have a rapid payback period. Other treatments include applying fixed layers of glazing over the historic windows, adding operable storm windows, or installing thermal glass in place of the existing glass. In combination with caulking and weatherstripping, these treatments can produce energy ratings rivaling those achieved by new units.[3]

Weatherstripping

The first step in any weatherization program, caulking, has been discussed above under "Routine Maintenance." The second step is the installation of weatherstripping where the operable portion of the sash, often called the ventilator, and the fixed frame come together to reduce perimeter air infiltration (see fig. 8). Four types of weatherstripping appropriate for metal windows are spring-metal, vinyl strips, compressible foam tapes, and sealant beads. The spring-metal, with an integral friction fit mounting clip, is recommended for steel windows in good condition. The clip eliminates the need for an applied glue; the thinness of the material insures a tight closure. The weatherstripping is clipped to the inside channel of the rolled metal section of the fixed frame. To insure against galvanic corrosion between the weatherstripping (often bronze or brass), and the steel window, the window must be painted prior to the installation of the weatherstripping. This weatherstripping is usually applied to the entire perimeter of the window opening, but in some cases, such as casement windows, it may be best to avoid weatherstripping the hinge side. The natural wedging action of the weatherstripping on the three sides of the window often creates an adequate seal.

Vinyl weatherstripping can also be applied to metal windows. Folded into a "V" configuration, the material forms a barrier against the wind. Vinyl weatherstripping is usually glued to the frame, although some brands have an adhesive backing. As the vinyl material and the applied glue are relatively thick, this form of weatherstripping may not be appropriate for all situations.

Compressible foam tape weatherstripping is often best for large windows where there is a slight bending or distortion of the sash. In some very tall windows having closure hardware at the sash mid-point, the thin sections of the metal window will bow away from the frame near the top. If the gap is not more than 1/4", foam weatherstripping can normally fill the space. If the gap exceeds this, the window may need to be realigned to close more tightly. The foam weatherstripping comes either with an adhesive or plain back; the latter variety requires application with glue. Compressible foam requires more frequent replacement than either spring-metal or vinyl weatherstripping.

A fourth type of successful weatherstripping involves the use of a caulking or sealant bead and a polyethylene bond breaker tape. After the window frame has been thoroughly cleaned with solvent, permitted to dry, and primed, a neat bead of low modulus (firm setting) caulk, such as silicone, is applied. A bond breaker tape is then applied to the operable sash covering the metal section where contact will occur. The window is then closed until the sealant has set (2-7 days, depending on temperature and humidity). When the window is opened, the bead will have taken the shape of the air infiltration gap and the bond breaker tape can be removed. This weatherstripping method appears to be successful for all types of metal windows with varying degrees of air infiltration.

Since the several types of weatherstripping are appropriate for different circumstances, it may be necessary to use more than one type on any given building. Successful weatherstripping depends upon using the thinnest material adequate to fill the space through which air enters. Weatherstripping that is too thick can spring the hinges, thereby resulting in more gaps.

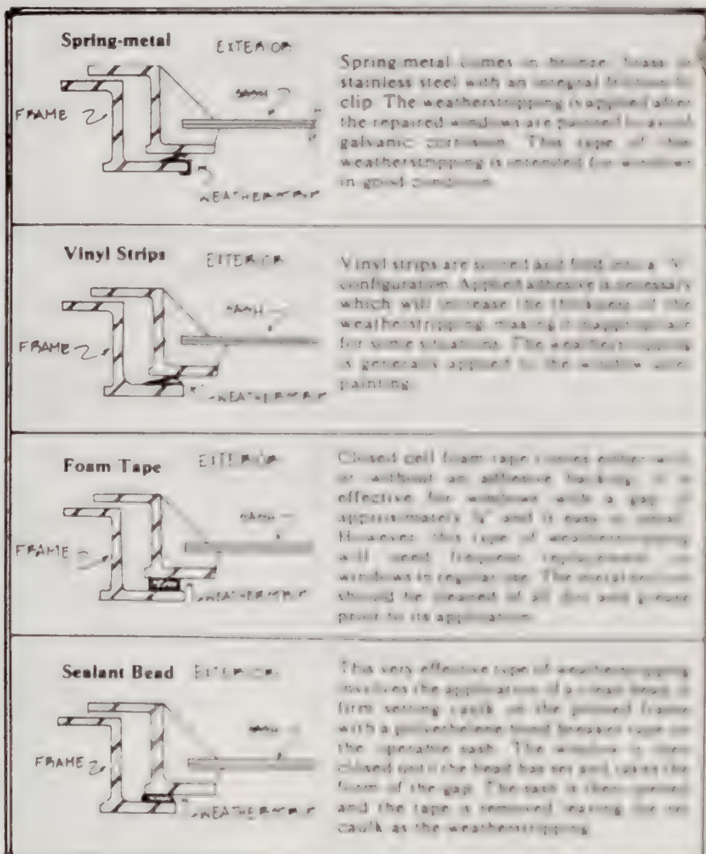

Fig. 8 APPROPRIATE TYPES OF WEATHERSTRIPPING FOR METAL WINDOWS. Weatherstripping is an important part of upgrading the thermal efficiency of historic steel windows. The chart above shows the jamb section of the window with the weatherstripping in place. Drawings: Sharon C. Park, AIA.

[3]One measure of energy efficiency is the U-value (the number of BTUs per hour transferred through a square foot of material). The lower the U-value, the better the performance. According to *ASHRAE HANDBOOK-1977 Fundamentals*, the U-value of historic rolled steel sash with single glazing is 1.3. Adding storm windows to the existing units or reglazing with 5/8" insulating glass produces a U-value of .69. These methods of weatherizing historic steel windows compare favorably with rolled steel replacement alternatives: with factory installed 1" insulating glass (.67 U-value); with added thermal-break construction and factory finish coatings (.62 U-value).

Thermal Glazing

The third weatherization treatment is to install an additional layer of glazing to improve the thermal efficiency of the existing window. The decision to pursue this treatment should proceed from careful analysis. Each of the most common techniques for adding a layer of glazing will effect approximately the same energy savings (approximately double the original insulating value of the windows); therefore, cost and aesthetic considerations usually determine the choice of method. Methods of adding a layer of glazing to improve thermal efficiency include adding a new layer of transparent material to the window; adding a separate storm window; and replacing the single layer of glass in the window with thermal glass.

The least expensive of these options is to install a clear material (usually rigid sheets of acrylic or glass) over the original window. The choice between acrylic and glass is generally based on cost, ability of the window to support the material, and long-term maintenance outlook. If the material is placed over the entire window and secured to the frame, the sash will be inoperable. If the continued use of the window is important (for ventilation or for fire exits), separate panels should be affixed to the sash without obstructing operability (see fig. 9). Glass or acrylic panels set in frames can be attached using magnetized gaskets, interlocking material strips, screws or adhesives. Acrylic panels can be screwed directly to the metal windows, but the holes in the acrylic panels should allow for the expansion and contraction of this material. A compressible gasket between the prime sash and the storm panel can be very effective in establishing a thermal cavity between glazing layers. To avoid condensation, 1/8" cuts in a top corner and diagonally opposite bottom corner of the gasket will provide a vapor bleed, through which moisture can evaporate. (Such cuts, however, reduce thermal performance slightly.) If condensation does occur, however, the panels should be easily removable in order to wipe away moisture before it causes corrosion.

The second method of adding a layer of glazing is to have independent storm windows fabricated. (Pivot and austral windows, however, which project on either side of the window frame when open, cannot easily be fitted with storm windows and remain operational.) The storm window should be compatible with the original sash configuration. For example, in paired casement windows, either specially fabricated storm casement windows or sliding units in which the vertical meeting rail of the slider reflects the configuration of the original window should be installed. The decision to place storm windows on the inside or outside of the window depends on whether the historic window opens in or out, and on the visual impact the addition of storm windows will have on the building. Exterior storm windows, however, can serve another purpose besides saving energy: they add a layer of protection against pollutants and vandals, although they will partially obscure the prime window. For highly ornamental windows this protection can determine the choice of exterior rather then interior storm windows.

The third method of installing an added layer of glazing is to replace the original single glazing with thermal glass. Except in rare instances in which the original glass is of special interest (as with stained or figured glass), the glass can be replaced if the hinges can tolerate the weight of the additional glass. The rolled metal sections for steel windows are generally from 1" - 1 1/2" thick. Sash of this thickness can normally tolerate thermal glass, which ranges from 3/8" - 5/8". (Metal glazing beads, readily available, are used to reinforce the muntins, which hold the glass.) This treatment leaves the window fully operational while preserving the historic appearance. It is, however, the most expensive of the treatments discussed here. (See fig. 6f).

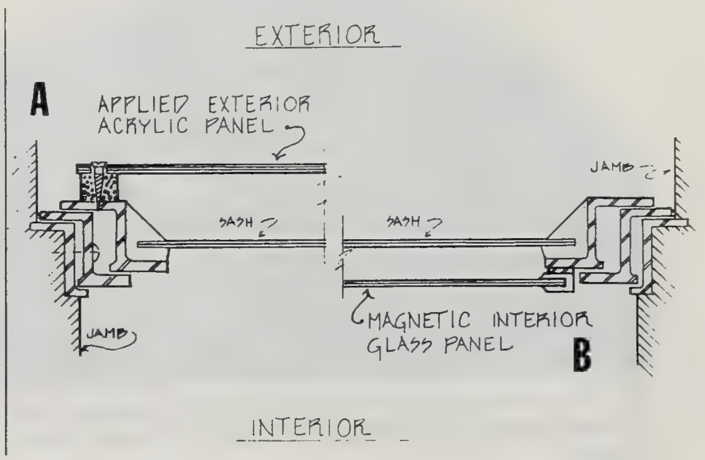

Fig. 9 Two examples of adding a second layer of glazing in order to improve the thermal performance of historic steel windows. Scheme A (showing jamb detail) is of a ¼" acrylic panel with a closed cell foam gasket attached with self-tapping stainless steel screws directly to the exterior of the outwardly opening sash. Scheme B (showing jamb detail) is of a glass panel in a magnetized frame affixed directly to the interior of the historic steel sash. The choice of using glass or acrylic mounted on the inside or outside will depend on the ability of the window to tolerate additional weight, the location and size of the window, the cost, and the long-term maintenance outlook. Drawing: Sharon C. Park, AIA.

WINDOW REPLACEMENT

Repair of historic windows is always preferred within a rehabilitation project. Replacement should be considered only as a last resort. However, when the extent of deterioration or the unavailability of replacement sections renders repair impossible, replacement of the entire window may be justified. In the case of significant windows, replacement in kind is essential in order to maintain the historic character of the building. However, for less significant windows, replacement with compatible new windows may be acceptable. In selecting compatible replacement windows, the material, configuration, color, operability, number and size of panes, profile and proportion of metal sections, and reflective quality of the original glass should be duplicated as closely as possible.

A number of metal window manufacturing companies produce rolled steel windows. While stock modern window designs do not share the multi-pane configuration of

ndows, most of these manufacturers can the historic configuration if requested, and the excessive for large orders (see figs. 10a and e manufacturers still carry the standard pre- ar II multi-light windows using the traditional or 14" x 20" glass sizes in industrial, commer- ity, and residential configurations. In addition, he modern steel windows have integral ipping, thermal break construction, durable ings, insulating glass, and other desirable

A six-story concrete manufacturing building prior to ment of the steel pivot windows. Photo: Charles

Close-up view of the new replacement steel windows hed the multi-lighted originals exactly. Photo: Charles

s manufactured from other materials generally tch the thin profiles of the rolled steel sections. , for example, is three times weaker than steel be extruded into a box-like configuration that eflect the thin historic profiles of most steel Wooden and vinyl replacement windows are not fabricated in the industrial style, nor can duce the thin profiles of the rolled steel sec- consequently are generally not acceptable nts.

For product information on replacement windows, the owner, architect, or contractor should consult manufacturers' catalogues, building trade journals, or the Steel Window Institute, 1230 Keith Building, Cleveland, Ohio 44115.

SUMMARY

The National Park Service recommends the retention of significant historic metal windows whenever possible. Such windows, which can be a character-defining feature of a historic building, are too often replaced with inappropriate units that impair rather than complement the overall historic appearance. The repair and thermal upgrading of historic steel windows is more practicable than most people realize. Repaired and properly maintained metal windows have greatly extended service lives. They can be made energy efficient while maintaining their contribution to the historic character of the building.

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This publication has been prepared pursuant to the Economic Recovery Tax Act of 1981, which directs the Secretary of the Interior to certify rehabilitations of historic buildings that are consistent with their historic character; the guidance provided in this brief will assist property owners in complying with the requirements of this law.

Preservation Briefs 13 has been developed under the technical editorship of Lee H. Nelson, AIA, Chief, Preservation Assistance Division, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240. Comments on the usefulness of this information are welcomed and can be sent to Mr. Nelson at the above address.

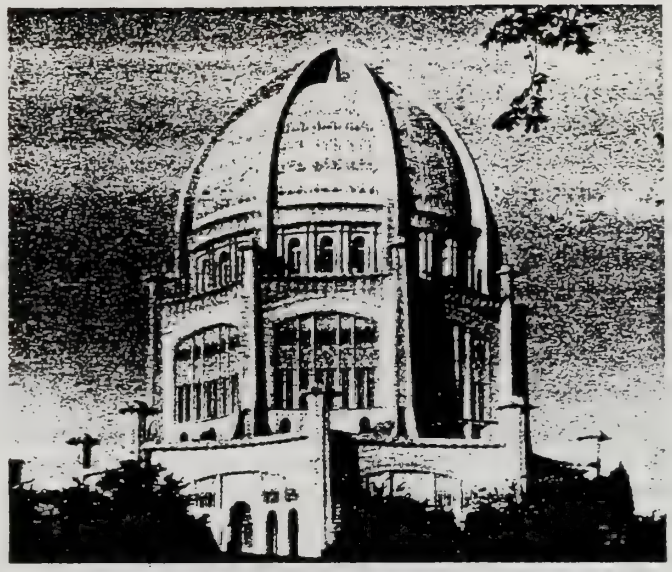
Exhibit JJ

EXHIBIT JJ.

PRESERVATION BRIEF #15:
PRESERVATION OF HISTORIC CONCRETE:
PROBLEMS AND GENERAL APPROACHES

WILLIAM B. CONEY, AIA.

15 PRESERVATION BRIEFS



ɛservation of Historic ıncrete: Problems and ːneral Approaches

iam B. Coney, A.I.A.
ȝ, Janney, Elstner Associates, Inc.

. Department of the Interior, National Park Service
ɕy Mountain Regional Office, Division of Cultural Resources

The Secretary of the Interior's "Standards for Rehabilitation" require that deteriorated architectural features shall be repaired rather than replaced. When the severity of deterioration requires removal of historic material, its replacement should match the material being replaced in composition, design, color, texture, and other visual qualities.

ıcrete" is a name applied to any of a number of ›ositions consisting of sand, gravel, crushed stone, her coarse material, bound together with various ... ıtitious materials, such as lime or nts. When water is added, the mix undergoes a ıical reaction and hardens. An extraordinarily ver- building material, concrete is used for the arian, the ornamental, and the monumental. While proponents of modern concrete considered it to ɛrmanent, it is, like all materials, subject to ioration. This Brief surveys the principal problems d by concrete deterioration, their likely causes, and ɔaches to their remedies. In almost every instance, dial work should only be undertaken by qualified ːssionals. Faulty concrete repair can worsen struc- problems and lead to further damage or safety rds. Concrete repairs are not the province of do- ırselfers. Consequently, the corrective measures ssed here are included for general information ɔses only; they do not provide "how to" advice.

ΓORICAL OVERVIEW

ʅomans found that the mixture of lime putty with ›lana, a fine volcanic ash, would harden under . The result was possibly the first hydraulic ce- It became a major feature of Roman building ce, and was used in many buildings and engi- ... projects such as bridges and aqueducts. Con- ...y was kept alive during the Middle ... and Africa, with the Spanish introduc- form of concrete to the New World in the first es of the 16th century. It was used by both the ʒh and English in coastal areas stretching from Florida to South Carolina. Called "tapia," or "tabby," the substance was a creamy white, monolithic masonry material composed of lime, sand, and an aggregate of shells, gravel, or stone mixed with water. This mass of material was placed between wooden forms, tamped, and allowed to dry, the building arising in layers, about one foot at a time.

Despite its early use, concrete was slow in achieving widespread acceptance as a building material in the United States. In 1853, the second edition of Orson S. Fowler's *A Home for All* publicized the advantages of "gravel wall" construction to a wide audience, and poured gravel wall buildings appeared across the United States (see fig. 1). Seguin, Texas, 35 miles east

Fig. 1. Milton House, Milton, Wisconsin (1844). An early example of gravel wall construction with 12- to 15-inch thick monolithic concrete walls coated on the exterior with stucco. Photo: William B. Coney.

of San Antonio, came to be called "The Mother of Concrete Cities" for some 90 concrete buildings made from local "lime water" and gravel (see fig. 2). Impressed by the economic advantages of poured gravel wall or "lime-grout" construction, the Quartermaster General's Office of the War Department embarked on a campaign to improve the quality of building for frontier military posts. As a result, lime-grout structures were built at several western posts, such as the buildings that were constructed with 12- or 18-inch-thick walls at Fort Laramie, Wyoming between 1872 and 1885. By the 1880s sufficient experience had been gained with unreinforced concrete to permit construction of much larger buildings. The Ponce de Leon Hotel in St. Augustine, Florida, is a notable example from this period (see fig. 3).

Reinforced concrete in the United States dates from 1860, when S.T. Fowler obtained a patent for a reinforced concrete wall. In the early 1870s William E. Ward built his own house in Port Chester, New York, using concrete reinforced with iron rods for all structural elements. Despite these developments, such construction remained a novelty until after 1880, when innovations introduced by Ernest L. Ransome made reinforced concrete more practicable. The invention of the horizontal rotary kiln allowed production of a cheaper, more uniform and reliable cement, and led to the greatly increased acceptance of concrete after 1900.

During the early 20th century Ransome in Beverly, Massachusetts, Albert Kahn in Detroit, and Richard E. Schmidt in Chicago promoted concrete for utilitarian buildings with their "factory style," featuring an exposed concrete skeleton filled with expanses of glass. Thomas Edison's cast-in-place reinforced concrete homes in Union Township, New Jersey, proclaimed a similarly functional emphasis in residential construction (see fig. 4). From the 1920s onward, concrete began to be used with spectacular design results: in James J. Earley and Louis Bourgeois' exuberant, graceful Baha'i Temple in Wilmette, Illinois (see cover); and in Frank Lloyd Wright's masterpiece "Fallingwater" near Mill Run, Pennsylvania (see fig. 5). Eero Saarinen's soaring Terminal Building at Dulles International Airport outside Washington, D.C., exemplifies the masterful use of concrete achieved in the Modern era.

Fig. 2. Sebastopol House, Seguin, Texas (1856). This Greek Revival dwelling is one of the few remaining poured-in-place concrete structures in this Texas town noted for its construction of over 90 concrete buildings in the mid-nineteenth century. The high parapets surrounding the flat roof were lined and served as a water reservoir to cool the house. Photo: Texas Historical Commission.

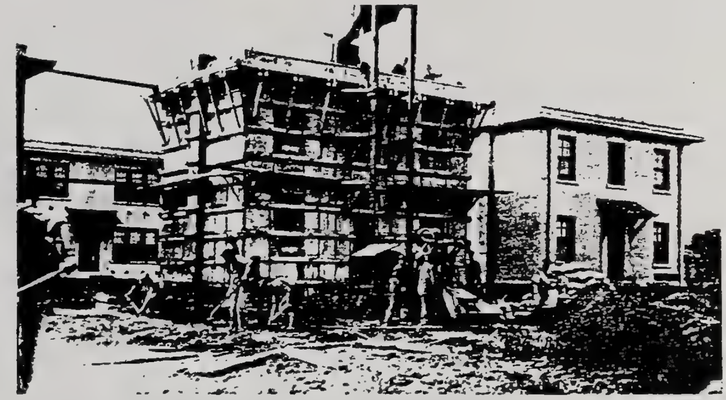


Fig. 4. Thomas A. Edison's Cast-in-Place Houses, Union Township, New Jersey (1909). This construction photo shows the formwork for the cast-in-place reinforced concrete houses built as low-cost housing using a standard 25- by 30-foot module. Photo: Edison National Historical Site.

Fig. 3. Ponce de Leon Hotel, St. Augustine, Florida (1885-87). An example of unreinforced concrete used on a grand scale, this Spanish Colonial Revival hotel was designed by Carrere and Hastings and commissioned by railroad magnate Henry Flagler. The building now serves as the main campus hall for Flagler College. Photo: Flagler College.

Fig. 5. "Fallingwater," near Mill Run, Pennsylvania (1936-37). This dramatic reinforced concrete residence by Frank Lloyd Wright is anchored into bedrock on the hillside and cantilevered over the stream. The great tensile strength of reinforced concrete made this type of construction possible. Photo: Paul Mayen.

Types of Concrete

Unreinforced concrete is a composite material containing aggregates (sand, gravel, crushed shell, or rock) held together by a cement combined with water to form a paste, and gets its name from the fact that it does not have any iron or steel reinforcing bars. It was the earliest form of concrete. The ingredients become a plastic mass that hardens as the concrete hydrates, or "cures." Unreinforced concrete, however, is relatively weak, and since the turn of the century has largely been replaced by reinforced concrete. *Reinforced concrete* is conrete strengthened by the inclusion of metal bars, which increase the tensile strength of concrete. Both unreinforced and reinforced concrete can be either cast in place or precast. *Cast-in-place* concrete is poured on-site into a previously erected formwork that is removed after the concrete has set. *Precast concrete* is molded off-site into building components. More recent developments in concrete technology include *post-tensioned concrete* and *pre-stressed concrete*, which feature greater strength and reduced cracking in reinforced structural elements.

CAUSES OF CONCRETE DETERIORATION

Deterioration in concrete can be caused by environmental factors, inferior materials, poor workmanship, inherent structural design defects, and inadequate maintenance (see figs. 6, 7, and 8).

Environmental factors are a principal source of concrete deterioration. Concrete absorbs moisture readily, and this is particularly troublesome in regions of recurrent freeze-thaw cycles. Freezing water produces expansive pressure in the cement paste or in nondurable aggregates. Carbon dioxide, another atmospheric component, can cause the concrete to deteriorate by reacting with the cement paste at the surface.

Materials and workmanship in the construction of early concrete buildings are potential sources of problems. For example, aggregates used in early concrete, such as cinders from burned coal and certain crushed brick, absorb water and produce a weak and porous concrete. Alkali-aggregate reactions within the concrete can result in cracking and white surface staining. Aggregates were not always properly graded by size to ensure an even distribution of elements from small to large. The use of aggregates with similarly sized particles normally produced a poorly consolidated and therefore weaker concrete.

Fig. 6. Battery Fortifications, Ft. Washington, Maryland (1891-97). This unreinforced concrete fortification exhibits several kinds of deterioration: the diagonal structural crack due to uneven settlement, the long horizontal crack at the cold joint, the spalling of the concrete surface coating, and vegetative growth. Photo: Sharon C. Park, AIA.

Fig. 7. Battery Commander's Station, Ft. Washington, Maryland (1904). This reinforced concrete tower with a cantilevered balcony is showing serious deterioration. Water has penetrated the slab, causing freeze-thaw spalling around the posts and corrosion of the reinforcing bars. This internal corrosion is causing expansion inside the slab and creating major horizontal cracks in the concrete. Under the balcony can be seen the network of hardened white calcified deposits, which have exuded through cracks in the concrete as a result of alkali-aggregate reaction. Photo: Lee H. Nelson, FAIA.

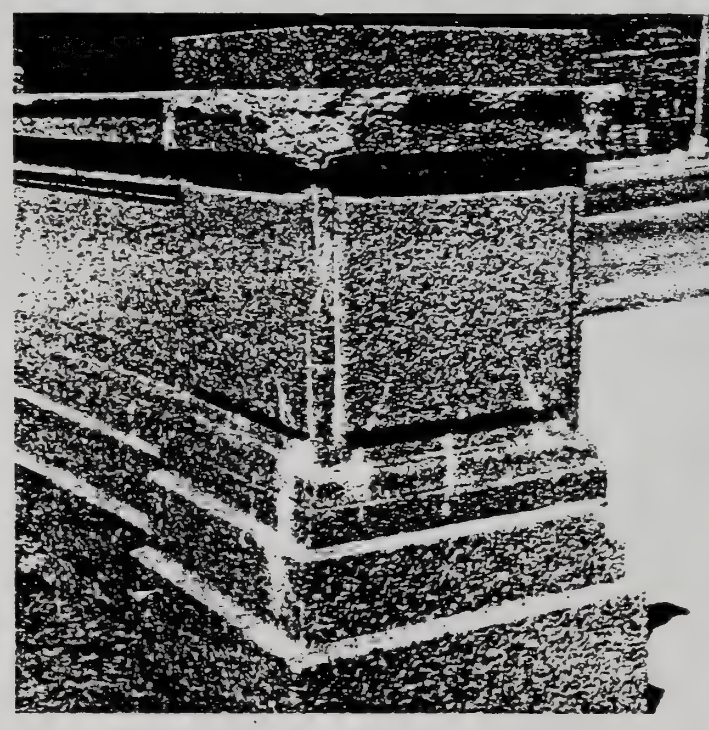


Fig. 8. Meridian Hill, Washington, D.C. (1934). This reinforced concrete pier has lost much of its projecting molding partly from accidental impact and partly from spalling induced by freeze-thaw action. Evidence of moisture leaching out from the interior through cracks is seen as white deposits on the surface of this exposed aggregate concrete. Photo: Lee H. Nelson, FAIA.

Early builders sometimes inadvertently compromised concrete by using seawater or beach sand in the mix or by using calcium chloride or a similar salt as an additive to make the concrete more "fireproof." A common practice, until recently, was to add salt to strengthen concrete or to lower the freezing point during cold-weather construction. These practices cause problems over the long term.

In addition, early concrete was not vibrated when poured into forms as it is today. More often it was tamped or rodded to consolidate it, and on floor slabs it was often rolled with increasingly heavier rollers filled with water. These practices tended to leave voids (areas of no concrete) at congested areas, such as at reinforcing bars at column heads and other critical structural locations. Areas of connecting voids seen when concrete forms are removed are known as "honeycombs" and can reduce the protective cover over the reinforcing bars.

Other problems caused by poor workmanship are not unknown today. If the first layer of concrete is allowed to harden before the next one is poured next to or on top of it, joints can form at the interface of the layers. In some cases, these "cold joints" visibly detract from the architecture, but are otherwise harmless. In other cases, "cold joints" can permit water to infiltrate, and subsequent free-thaw action can cause the joints to move. Dirt packed in the joints allows weeds to grow, further opening paths for water to enter. Inadequate curing can also lead to problems. If moisture leaves newly poured concrete too rapidly because of low humidity, excessive exposure to sun or wind, or use of too porous a substrate, the concrete will develop shrinkage cracks and will not reach its full potential strength.

Structural Design Defects in historic concrete structures can be an important cause of deterioration. For example, the amount of protective concrete cover around reinforcing bars was often insufficient. Another design problem in early concrete buildings is related to the absence of standards for expansion-contraction joints to prevent stresses caused by thermal movements, which may result in cracking.

Improper Maintenance of historic buildings can cause long-term deterioration of concrete. Water is a principal source of damage to historic concrete (as to almost every other material) and prolonged exposure to it can cause serious problems. Unrepaired roof and plumbing leaks, leaks through exterior cladding, and unchecked absorption of water from damp earth are potential sources of building problems. Deferred repair of cracks allowing water penetration and freeze-thaw attacks can even cause a structure to collapse. In some cases the application of waterproof surface coatings can aggravate moisture-related problems by trapping water vapor within the underlying material.

MAJOR SIGNS OF CONCRETE DETERIORATION

Cracking occurs over time in virtually all concrete. Cracks vary in depth, width, direction, pattern, location, and cause. Cracks can be either active or dormant (inactive). Active cracks widen, deepen, or migrate through the concrete. Dormant cracks remain unchanged. Some dormant cracks, such as those caused by shrinkage during the curing process, pose no danger, but if left unrepaired, they can provide convenient channels for moisture penetration, which normally causes further damage.

Structural cracks can result from temporary or continued overloads, uneven foundation settling, or original design inadequacies. Structural cracks are active if the overload is continued or if settlement is ongoing; they are dormant if the temporary overloads have been removed, or if differential settlement has stabilized. Thermally-induced cracks result from stresses produced by temperature changes. They frequently occur at the ends or corners of older concrete structures built without expansion joints capable of relieving such stresses. Random surface cracks (also called "map" cracks due to their resemblance to the lines on a road map) that deepen over time and exude a white gel that hardens on the surface are caused by an adverse reaction between the alkalis in a cement and some aggregates.

Since superficial repairs that do not eliminate underlying causes will only tend to aggravate problems, professional consultation is recommended in almost every instance where noticable cracking occurs.

Spalling is the loss of surface material in patches of varying size. It occurs when reinforcing bars corrode, thus creating high stresses within the concrete. As a result, chunks of concrete pop off from the surface. Similar damage can occur when water absorbed by porous aggregates freezes. Vapor-proof paints or sealants, which trap moisture beneath the surface of the impermeable barrier, also can cause spalling. Spalling may also result from the improper consolidation of concrete during construction. In this case, water-rich cement paste rises to the surface (a condition known as laitance). The surface weakness encourages scaling, which is spalling in thin layers.

Deflection is the bending or sagging of concrete beams, columns, joists, or slabs, and can seriously affect both the strength and structural soundness of concrete. It can be produced by overloading, by corrosion, by inadequate construction techniques (use of low-strength concrete or undersized reinforcing bars, for example), or by concrete creep (long-term shrinkage). Corrosion may cause deflection by weakening and ultimately destroying the bond between the rebar and the concrete, and finally by destroying the reinforcing bars themselves. Deflection of this type is preceded by significant cracking at the bottom of the beams or at column supports. Deflection in a structure without

widespread cracking, spalling, or corrosion is frequently due to concrete creep.

Stains can be produced by alkali-aggregate reaction, which forms a white gel exuding through cracks and hardening as a white stain on the surface. Efflorescence is a white, powdery stain produced by the leaching of lime from Portland cement, or by the pre-World War II practice of adding lime to whiten the concrete. Discoloration can also result from metals inserted into the concrete, or from corrosion products dripping onto the surface.

Erosion is the weathering of the concrete surface by wind, rain, snow, and salt air or spray. Erosion can also be caused by the mechanical action of water channeled over concrete, by the lack of drip grooves in beltcourses and sills, and by inadequate drainage.

Corrosion, the rusting of reinforcing bars in concrete, can be a most serious problem. Normally, embedded reinforcing bars are protected against corrosion by being buried within the mass of the concrete and by the high alkalinity of the concrete itself. This protection, however, can be destroyed in two ways. First, by carbonation, which occurs when carbon dioxide in the air reacts chemically with cement paste at the surface and reduces the alkalinity of the concrete. Second, chloride ions from salts combine with moisture to produce an electrolyte that effectively corrodes the reinforcing bars. Chlorides may come from seawater additives in the original mix, or from prolonged contact with salt spray or de-icing salts. Regardless of the cause, corrosion of reinforcing bars produces rust, which occupies significantly more space than the original metal, and causes expansive forces within the concrete. Cracking and spalling are frequent results. In addition, the load-carrying capacity of the structure can be diminished by the loss of concrete, by the loss of bond between reinforcing bars and concrete, and by the decrease in thickness of the reinforcing bars themselves. Rust stains on the surface of the concrete are an indication that internal corrosion is taking place.

PLANNING FOR CONCRETE PRESERVATION

Whatever the causes of deterioration, careful analysis, supplemented by testing, is vital to the success of any historic concrete repair project. Undertaken by experienced engineers or architects, the basic steps in a program of testing and analysis are document review, field survey, testing, and analysis.

Document Review. While plans and specifications for older concrete buildings are rarely extant, they can be an invaluable aid, and every attempt should be made to find them. They may provide information on the intended composition of the concrete mix, or on the type and location of reinforcing bars. Old photographs, records of previous repairs, documents for buildings of the same basic construction or age, and news reports may also document original construction or changes over time.

Field Survey. A thorough visual examination can assist in locating and recording the type, extent, and severity of stress, deterioration, and damage.

Testing. Two types of testing, on-site and laboratory, can supplement the field condition survey as necessary. On-site, nondestructive testing may include use of a calibrated metal detector or sonic tests to locate the position, depth, and direction of reinforcing bars (see fig. 9). Voids can frequently be detected by "sounding" with a metal hammer. Chains about 30 inches long attached to a 2-foot-long crossbar, dragged over the slabs while listening for hollow reverberations, can locate areas of slabs that have delaminated. In order to find areas of walls that allow moisture to penetrate to the building interior, areas may be tested from the outside by spraying water at the walls and then inspecting the interior for water. If leaks are not readily apparent, sophisticated equipment is available to measure the water permeability of concrete walls.

If more detailed examinations are required, nondestructive instruments are available that can assist in determining the presence of voids or internal cracks, the location and size of rebars, and the strength of the concrete. Laboratory testing can be invaluable in determining the composition and characteristics of historic concrete and in formulating a compatible design mix

Fig. 9. Nondestructive sonic tests are one way of determining the location and soundness of internal reinforcing bars and the hardness of the concrete. There are a variety of other nondestructive tests provided by professional consultants that will help in the evaluation of the structural integrity of concrete prior to major repair work. Photo: Feld, Kaminetzky and Cohen and American Concrete Institute.

for repair materials (see fig. 10). These tests, however, are expensive. A well-equipped concrete laboratory can analyze concrete samples for strength, alkalinity, carbonation, porosity, alkali-aggregate reaction, presence of chlorides, and past compostion.

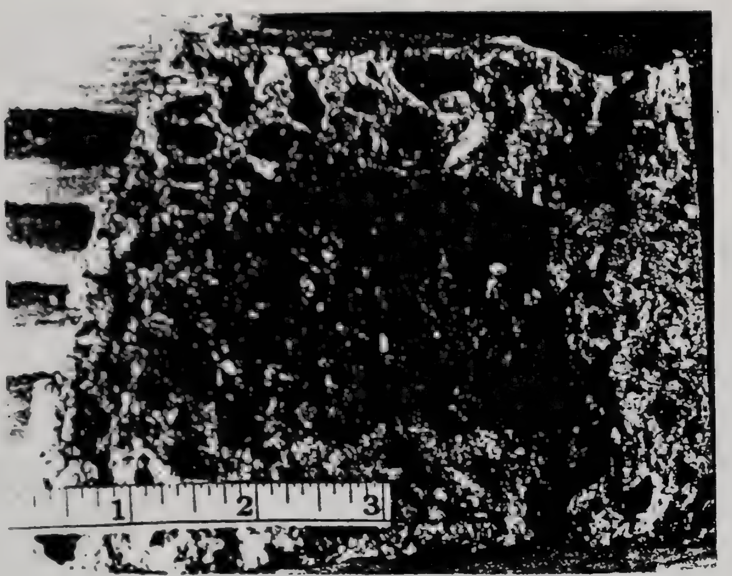


Fig. 10. Testing of actual samples of concrete in the lab may be necessary to determine the strength and condition of the concrete. In this sample, the surface, which is lighter than the sound concrete core, shows that carbonation has taken place. Carbonation reduces the alkalinity in concrete and may hasten corrosion of reinforcing bars close to the surface. Photo: Stella L. Marusin.

Analysis. Analysis is probably the most important step in the process of evaluation. As survey and test results are revised in conjunction with available documentation, the analysis should focus on determining the nature and causes of the concrete problems, on assessing both the short-term and long-term effects of the deterioration, and on formulating proper remedial measures.

CONCRETE REPAIR

Repairs should be undertaken only after the planning measures outlined above have been followed. Repair of historic concrete may consist of either patching the historic material or filling in with new material worked to match the historic material. If replacement is necessary, duplication of historic materials and detailing should be as exact as possible to assure a repair that is functionally and aesthetically acceptable (see fig. 11). The correction and elimination of concrete problems can be difficult, time-consuming, and costly. Yet the temptation to resort to temporary solutions should be avoided, since their failure can expose a building to further and more serious deterioration, and in some cases can mask underlying structural problems that could lead to serious safety hazards (see fig. 12).

Principal concrete repair treatments are discussed below. While they are presented separately here, in practice, preservation projects typically incorporate multiple treatments (see figs. 13a-i).

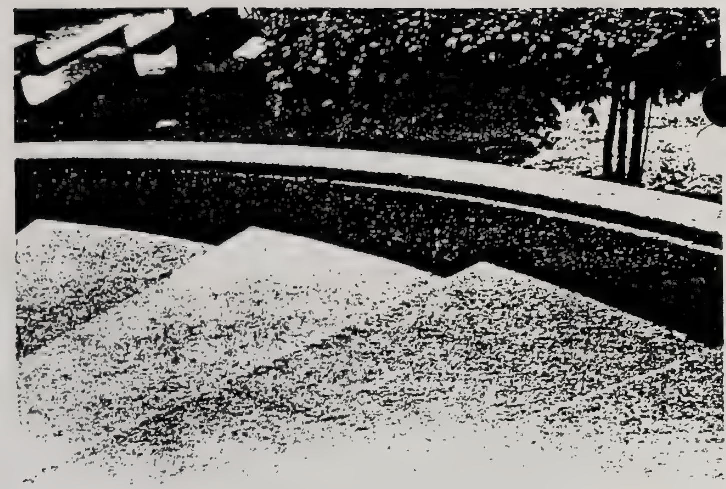


Fig. 11. Meridian Hill, Washington, D.C. (1934). It is important to match the visual qualities, such as color and texture, when repairs or replacement sections are undertaken. In this case, the new replacement step, located second from the left, matches the original pebble-finish surface of the adjacent historic steps. Photo: Sharon C. Park, AIA.

Fig. 12. Without proper preparation and correction of a pre-existing problem, repairs will fail. Insufficient concrete at the surface caused this patch around a reinforcing bar to fail within a year. In this case, a structural engineer should have assessed the need for this rod so close to the surface. Redundant rods are often cut out prior to patching. Photo: Alonzo White.

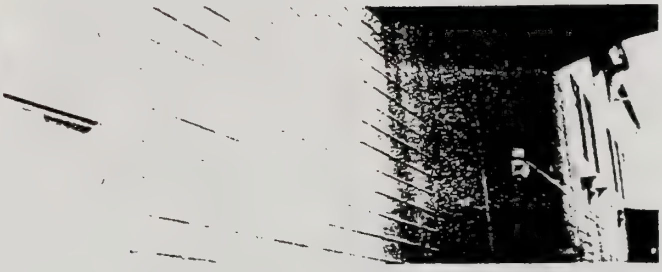


Fig. 13a. Buckling concrete under a painted surface indicates underlying deterioration. It is often difficult to assess the amount of deterioration until the area has been cleaned and examined closely.

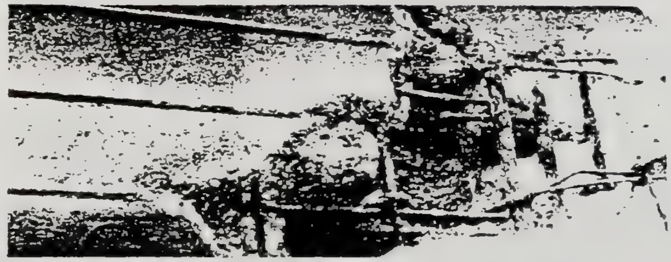


Fig. 13b. Upon removal of the deteriorated surface, a pocket of poorly mixed concrete (mostly sand and gravel) was easily chiseled out. The reinforcing rods were in good condition.

Fig. 13c. Narrow cracks often need to be widened to receive concrete patches. Here a pneumatic chisel is being used.

Fig. 13d. Deteriorated or redundant reinforcing bars are removed after evaluation by a structural engineer. An acetylene torch is being used to cut out the bars.

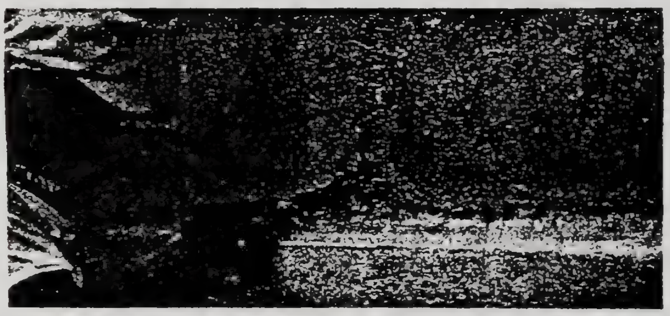


Fig. 13e. A spalled area of concrete has been cleaned back to a sound surface, and is being coated with a bonding agent to increase adherence of the new concrete patch.

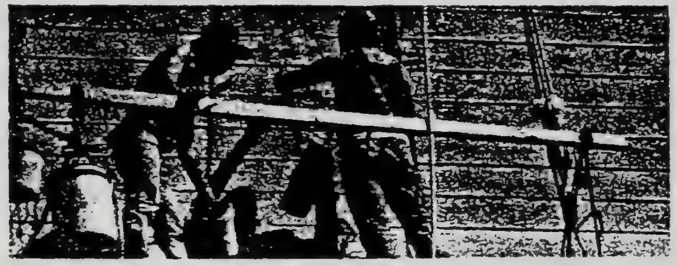


Fig. 13f. Workmen are applying patching concrete and using a trowel to form ridges to match the appearance of the historic concrete ridges that were originally created by the form boards.

Fig. 13g. A soft brush is used to smooth the patch and to blend it with the adjacent historic concrete.

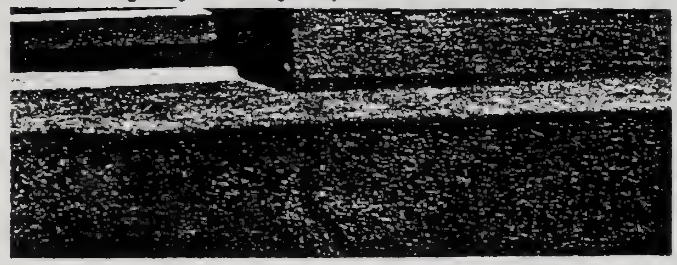


Fig. 13h. This active crack at a window sill and in the foundation wall has been filled with a flexible sealant. This area was subsequently painted with a masonry paint compatible with the sealant.

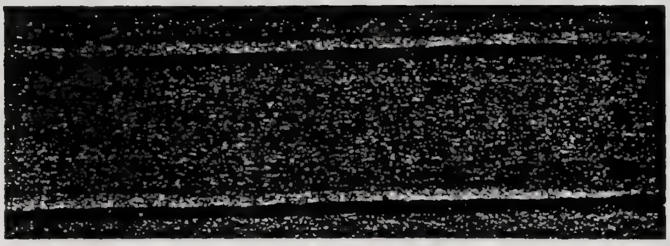


Fig. 13i. Upon completion of all repairs, the building was painted. The finished repair of the deterioration seen in 13a and b is shown in this photograph. The patch matches the texture and detailing of the historic concrete.

Fig. 13a-i. Virginia Heating Plant, Arlington, Virginia (1941). This reinforced concrete building exhibits several serious problems, including cracking, spalling, and corrosion of reinforcing bars. As a result of careful planning and close supervision, successful repairs have been carried out. Photos: Alonzo White and Sharon C. Park, AIA.

Repair of Cracking. Hairline, nonstructural cracks that show no sign of worsening normally need not be repaired. Cracks larger than hairline cracks, but less than approximately one-sixteenth of an inch, can be repaired with a mix of cement and water. If the crack is wider than one-sixteenth of an inch, fine sand should be added to the mix to allow for greater compactibility, and to reduce shrinkage during drying. Field trials will determine whether the crack should be routed (widened and deepened) minimally before patching to allow sufficient penetration of the patching material. To ensure a long-term repair, the patching materials should be carefully selected to be compatible with the existing concrete as well as with subsequent surface treatments such as paint or stucco.

When it is desirable to reestablish the structural integrity of a concrete structure involving dormant cracks, epoxy injection repair should be considered. An epoxy injection repair is made by sealing the crack on both sides of a wall or a structural member with an epoxy mortar, leaving small holes, or "ports" to receive the epoxy resin. After the surface mortar has hardened, epoxy is pumped into the ports. Once the epoxy in the crack has hardened, the surface mortar can be ground off, but the repair may be visually noticeable. (It is possible to inject epoxy without leaving noticeable patches, but the procedure is much more complex.)

Other cracks are active, changing their width and length. Active structural cracks will move as loads are added or removed. Thermal cracks will move as temperatures fluctuate. Thus, expansion-contraction joints may have to be introduced before repair is undertaken. Active cracks should be filled with sealants that will adhere to the sides of the cracks and will compress or expand during crack movement. The design, detailing, and execution of sealant-filled cracks require considerable attention, or else they will detract from the appearance of the historic building.

Random (map) cracks throughout a structure are difficult to correct, and may be unrepairable. Repair, if undertaken, requires removing the cracked concrete. A compatible concrete patch to replace the removed concrete is then installed. For some buildings without significant historic finishes, an effective and economical repair material is probably a sprayed concrete coating, troweled or brushed smooth. Because the original concrete will ultimately contaminate new concrete, buildings with map cracks will present continuing maintenance problems.

Repair of Spalling. Repair of spalling entails removing the loose, deteriorated concrete and installing a compatible patch that dovetails into the existing sound concrete. In order to prevent future crack development after the spall has been patched and to ensure that the patch matches the historic concrete, great attention must be paid to the treatment of rebars, the preparation of the existing concrete substrate, the selection of compatible patch material, the development of good contact between patch and substrate, and the curing of the patch.

Once the deteriorated concrete in a spalled area has been removed, rust on the exposed rebars must be removed by wire brush or sandblasting. An epoxy coating applied immediately over the cleaned rebars will diminish the possiblity of further corrosion. As a general rule, if the rebars are so corroded that a structural engineer determines they should be replaced, new supplemental reinforcing bars will normally be required, assuming that the rebar is important to the strength of the concrete. If not, it is possible to cut away the rebar.

Proper preparation of the substrate will ensure a good bond between the patch and the existing concrete. If a large, clean break or other smooth surface is to be patched, the contact area should be roughened with a hammer and chisel. In all cases, the substrate should be kept moist with wet rags, sponges, or running water for at least an hour before placement of the patch. Bonding between the patch and substrate can be encouraged by scrubbing the substrate with cement paste, or by applying a liquid bonding agent to the surface of the substrate. Admixtures such as epoxy resins, latexes, and acrylics in the patch may also be used to increase bonding, but this may cause problems with color matching if the surfaces are to be left unpainted.

Compatible matching of patch material to the existing concrete is critical for both appearance and durability. In general, repair material should match the composition of the original material (as revealed by laboratory analysis) as closely as possible so that the properties of the two materials, such as coefficient of thermal expansion and strength, are compatible. Matching the color and texture of the existing concrete requires special care. Several test batches of patching material should be mixed by adding carefully selected mineral pigments that vary slightly in color. After the samples have cured, they can be compared to the historic concrete and the closest match selected.

Contact between the patch and the existing concrete can be enhanced through the use of anchors, preferably stainless-steel hooked pins, placed in holes drilled into the structure and secured in place with epoxy. Good compaction of the patch material will encourage the contact. Compaction is difficult when the patch is "laid-up" with a trowel without the use of forms; however, by building up thin layers of concrete, each layer can be worked with a trowel to achieve compaction. Board forms will be necessary for large patches. In cases where the existing concrete has a significant finish, care must be taken to pin the form to the existing concrete without marring the surface. The patch in the form can be consolidated by rodding or vibration.

Because formed concrete surfaces normally develop a sheen that does not match the surface texture of most historic concrete, the forms must be removed before the patch has fully set. The surface of the patch must then be finished to match the historic concrete. A brush or wet sponge is particularly useful in achieving matching textures. It may be difficult to match historic concrete surfaces that were textured, as a result of exposed aggregate for example, but it is important that these visual qualities be matched. Once the forms are removed, holes from the bolts must also be patched and finished to match adjacent surfaces.

Regardless of size, a patch containing cement binder (especially Portland cement) will tend to shrink during drying. Adequate curing of the patch may be achieved by keeping it wet for several days with damp burlap bags. It should be noted that although greater amounts of sand will reduce overall shrinkage, patches with a high sand content normally will not bond well to the substrate.

Repair of Deflection. Deflection can indicate significant structural problems and often requires the strengthening or replacement of structural members. Because deflection can lead to structural failure and serious safety hazards, its repair should be left to engineering professionals.

Repair of Erosion. Repair of eroded concrete will normally require replacing lost surface material with a compatible patching material (as outlined above) and then applying an appropriate finish to match the historic appearance. The elimination of water coursing over concrete surfaces should be accomplished to prevent further erosion. If necessary, drip grooves at the underside of overhanging edges of sills, beltcourses, cornices, and projecting slabs should be installed.

SUMMARY

Many early concrete buildings in the United States are threatened by deterioration. Effective protection and maintenance are the keys to the durability of concrete. Even when historic concrete structures are deteriorated, however, many can be saved through preservation projects involving sensitive repair (see figs. 14a-c), or replacement of deteriorated concrete with carefully selected matching material (see figs. 15a-c). Successful restoration of many historic concrete structures in America demonstrates that techniques and materials now available can extend the life of such structures for an indefinite period, thus preserving significant cultural resources.

Fig. 14a. Spalled concrete was most noticeable at locations of concentrated rebars. Deteriorated concrete, the 1960s stucco finish, and corrosion were removed by grit-blasting. Photo: Robert Bell.

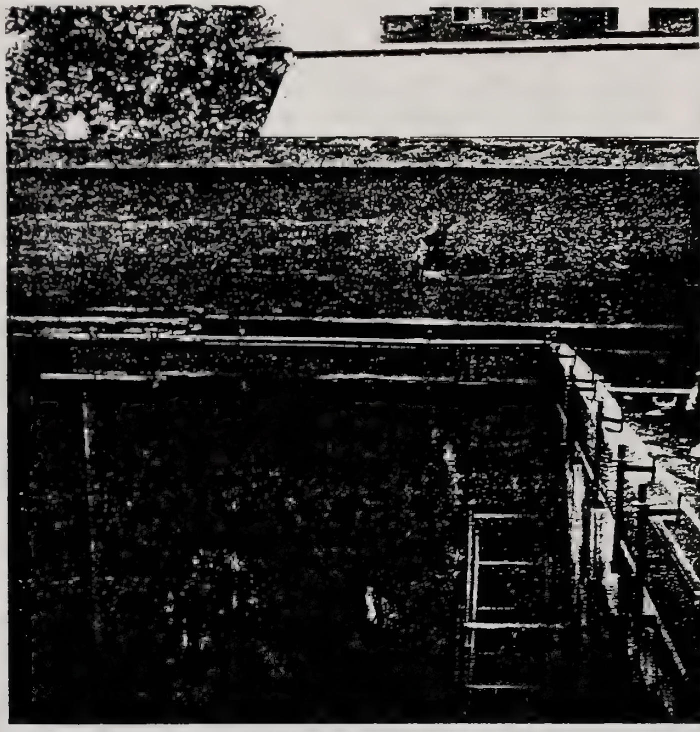


Fig. 14b. Board screeds were attached to the building to recreate the sharp edges of the original detail. Photo: Robert Bell.

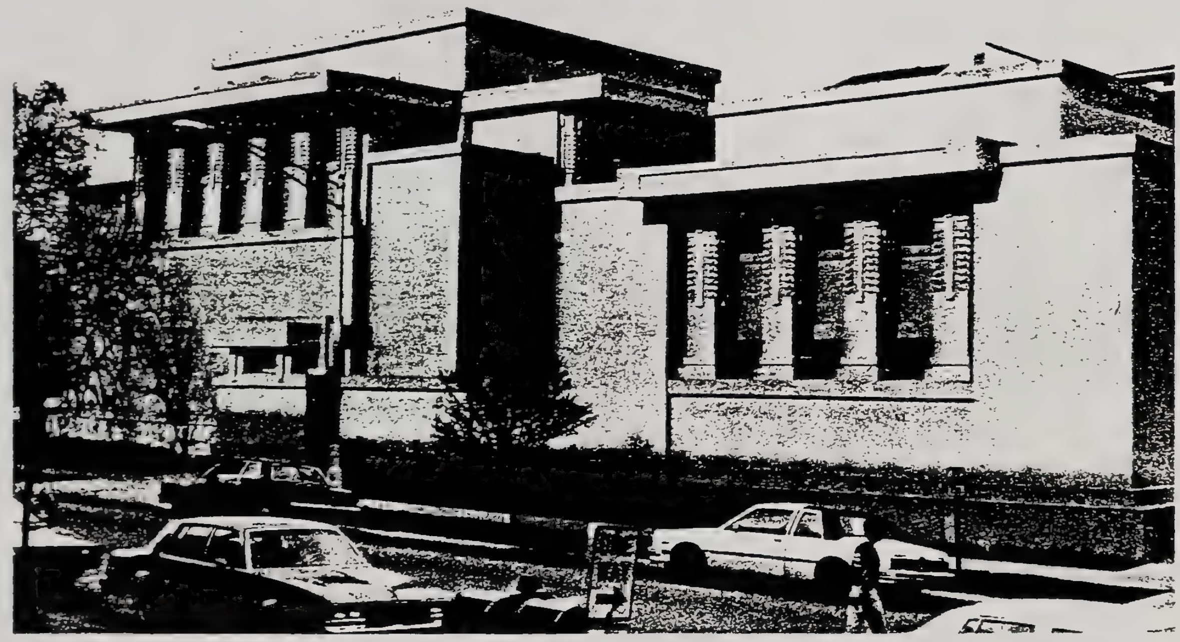


Fig. 14c. Once the repair work was complete, the entire building was sprayed with a concrete mixture consisting of pea-gravel, cement, and sand, which was then hand-troweled. Finally, the building was lightly grit-blasted to remove the cement paste and reproduce the exposed agregate finish. Photo: Harry J. Hunderman.

Fig. 14a-c. Unity Temple, Oak Park, Illinois (1906). Architect Frank Lloyd Wright used cast-in-place concrete with an exposed aggregate finish. However, reinforcing bars placed too close to the surface resulted in corrosion, cracking, and spalling. A superficial repair in the 1960s coated the surface with a concrete mix and Portland cement paint which produced a stucco-like finish and accelerated deterioration. Repair work was undertaken in 1971.

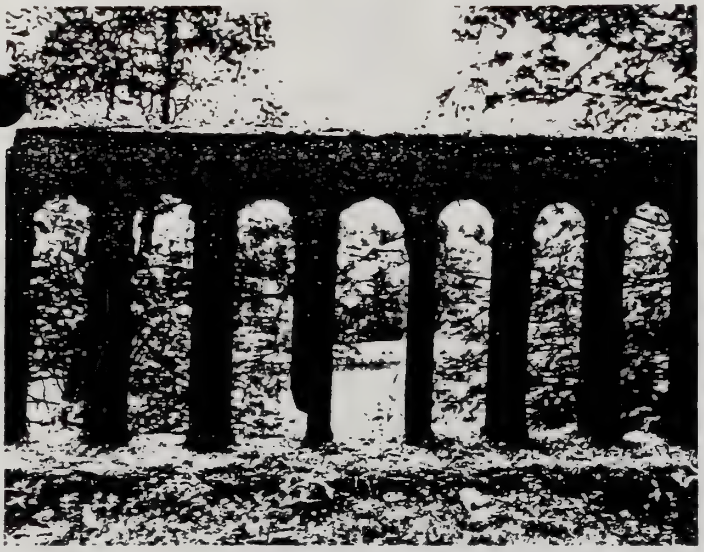


Fig. 15a. The spindle-type railings were deteriorated beyond repair. The concrete was cracked or broken and the center reinforcing rods were exposed and badly rusted.

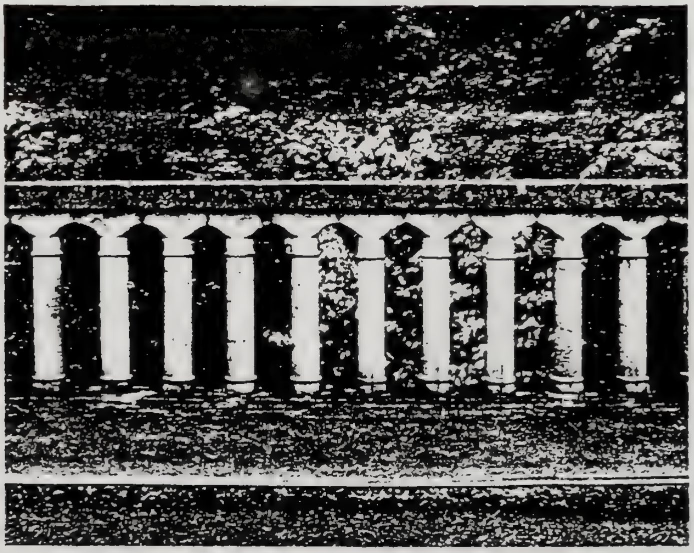


Fig. 15b. Deteriorated spindles were removed. The original 1914 molds were still available and used in casting new concrete spindles, but had they not been available, new molds could have been made to match the originals.

Fig. 15c. The new concrete spindles have been installed. This sensitive renovation reused the historic concrete cap railing and stone piers, as they were still in sound condition.

Fig. 15a-c. Columbia River Highway, Oregon. This historic highway overlooking the Columbia River Gorge was constructed from 1913 to 1922 and contains a number of significant concrete bridges. These photos illustrate the sensitive replacement of the concrete spindle-type balusters on the Young Creek (Shepperd's Dell) Bridge of 1914. Photos: James Norman, Oregon Department of Transportation.

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Cover: Baha'i Temple, Wilmette, Illinois (1933). Photo: William B. Coney.

Exhibit KK

EXHIBIT KK.

PRESERVATION LEAGUE OF NEW YORK STATE,
TECHNICAL SERIES/NO. 5:
PROPERTY OWNER'S GUIDE TO THE
MAINTENANCE AND REPAIR OF STONE BUILDINGS

CORNELIA BROOKE GILDER
1977

Preservation League of New York State

Technical Series/No. 5

Property Owner's Guide to the Maintenance and Repair of Stone Buildings

By Cornelia Brooke Gilder

The architectural history of New York State is, in large part, recorded in stone. One-third of the structures listed individually on the National Register of Historic Places, for example, are constructed of stone. Each year their facades bake in the summer sun and freeze in subzero winter weather; their cornices glitter with icicles in one season and run with torrential rains in the other three. Stone buildings in cities are cloaked with pollutants and splashed by salty slush from winter streets and sidewalks. To survive these ravages, stone buildings demand vigilant care. This pamphlet is designed to help those responsible for historic stone buildings in New York State make informed choices about maintenance and repair.

Identifying the Stone

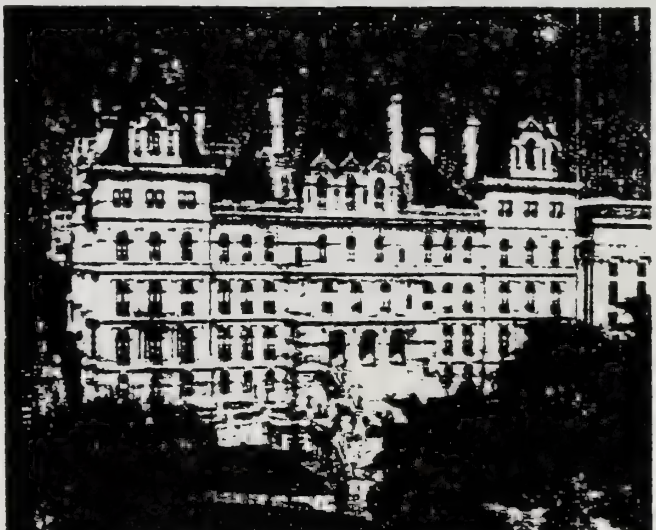
The first step in a maintenance and repair plan is to identify the types of stone used in the construction of the building.

An 18th or early 19th century building was probably constructed of a local stone. During this period builders depended upon readily available materials and usually used either loose fieldstones or roughly finished stone blocks taken from nearby exposed outcroppings. Stone was transported long distances only in rare cases; examples include important public buildings, such as the Albany Academy (1815-17) of Nyack, New York, sandstone and the New York City Hall (1803-12) of West Stockbridge, Massachusetts, marble. By the mid-19th century, mechanized quarrying techniques and railways made more kinds of stone available. Popular taste also became an important but sometimes capricious factor in the choice of stone. Connecticut brownstone, which was cheaper than the more durable New York State sandstones, was very popular in New York City during the mid-19th century. Rockfaced sandstone and granite supplanted smoother stones as Romanesque revival architecture became fashionable during the late 19th century. Minor exterior decoration as well as interior work in marble and other exotic foreign stones were also popular during this period.

Visual identification may seem adequate with familiar local stones, but the same stone from different quarries within one region or even from a single quarry can vary significantly in color and texture. Different finishes can also alter the appearance of stone; a chiseled block of marble, for instance, appears cloudy and veinless compared with a polished block from the same source.

Historical documentation can be an important aid in determining or verifying the identity of building stones. Contemporary newspaper accounts often mention details about construction materials. Receipts from a quarry or stone dealer may survive among old building records. Several turn-of-the-century books on the building stone industry specify the types of stone used in some New York State buildings.[1]

The building stones most commonly used in New York State are described on the following pages; included are those quarried within the state as well as those imported from New England and the Midwest.



The New York State Capitol (1867-1899) is constructed of fine-grained Hallowell granite from Maine.

Marble

Marble is a metamorphic rock composed mainly of carbonate of lime (calcite) or carbonates of lime and magnesia (dolomite). Originally a limestone, its constituents rearranged and crystallized under compression and heat. Marble can be polished due to its structure of coarse, uniform crystals. Once the polish is lost, the exposed marble face will roughen and weather. The durability of marble is dependent upon its compactness and the intermeshing of its grains.[2] A highly compact marble absorbs little water and thus is less vulnerable to damage from frost than more porous, sedimentary stones. Both marble and limestone, however, are susceptible to decay from atmospheric gases.

The calcite or dolomite in marble accounts for its whiteness; impurities produce color, either uniformly or in streaks. Champlain marbles, used chiefly for interiors, include black varieties from Plattsburgh and Glens Falls, verde antique from Port Henry, and variegated white, gray and pink marbles. A rich blue mottled marble, known for its lustrous polish, was quarried at Gouverneur and widely marketed from the late 1870's through the 1930's.

Marble was first quarried commercially in New York State around 1809 at Sing Sing (now Ossining), which is situated on the outcroppings of the great marble belt which extends along the west side of the Appalachian Mountains from Vermont to Georgia and Tennessee.[3] New York State's best quality marble came from Tuckahoe and Pleasantville, and these quarries eventually eclipsed others in Westchester and Dutchess counties.

Although marble quarrying continued into the 20th century at Wingdale and Gouverneur, the vast marble quarries in Vermont were virtually unrivaled as the source of marble throughout the Northeast. These quarries, worked since 1788, still produce a wide variety of marbles for exterior and interior use, which are lavishly exhibited in the towers of the Empire State Plaza (begun 1965) in Albany.

Because marble can be quarried in massive blocks, it proved popular for monumental buildings. In New York City it was used early in the 19th century not only for public buildings but also for residences and storefronts. However, its use declined sharply with the introduction of sandstone in the 1840's and of Maine granite and Indiana limestone later in the century. With the revival of classical architecture at the turn of the century, marble again became a popular building material. Many important public buildings were faced entirely with marble, like Buffalo's Albright-Knox Art Gallery (1900-5) of Cockeysville, Maryland, marble, and the New York City Public Library (1898-1911) of Dorset, Vermont, marble. Turn-of-the-century brick buildings often had marble trim.

Limestone

Limestone is a sedimentary rock that was deposited in sequential layers, or beds, over time. It is composed primarily of carbonate of lime. The texture of limestone ranges from finely grained and compact to oolitic, which is made up of visible, round grains resembling fish eggs. Characteristic of most limestone is the presence of minute fossils and shell fragments that may stand out in relief as the cementing material is gradually washed away. When clay or shaly seams have weathered out, as is common with Onondaga limestone, the laminations become noticeable. Like marble, limestone varies from

The elegant Herkimer County Jail (1835) is typical of many buildings in the Mohawk Valley that were constructed of local limestone during the early 19th century.

pure white to buff, gray, and darker colors, depending upon the presence of impurities. Of all building stones, limestone is the most vulnerable to decay from atmospheric pollutants, because the calcium carbonate becomes more soluble in water carrying carbon dioxide or sulphur dioxide.

A band of limestone lies under much of the center of New York State, extending through the Mohawk Valley to the Niagara Frontier, up the Black River Valley to parts of the North Country, along the Champlain Valley, and along the Roundout Valley southeast of Kingston. Throughout the 18th and early 19th centuries numerous small quarries served local needs, as good quality limestone could be quarried near the surface in many places. Finely dressed limestone blocks were used in the construction of the Erie Canal and hundreds of elegant federal and Greek revival public buildings, mills, hotels, churches, banks and houses of Upstate New York.

Major quarries in New York were located at Split Rock and at the Onondaga Indian Reservation near Syracuse, where the famed Onondaga limestone was worked, as well as at Tribes Hill, Prospect, Cobleskill, and Auburn. But even these larger quarries rarely survived into the mid-19th century when power channelling machines and gang saws were used. Only the Syracuse quarries were worked on a large scale during the 20th century.

Indiana limestone was first introduced into New York during the late 19th century, when it became a popular alternative to brownstone in New York City as evidenced in numerous limestone rowhouses on the Upper West Side.[4] Durable yet easily worked, Indiana limestone continues today to be one of the most important building stones in New York State; notable examples of its use are the Eastman Theater (1922) in Rochester, Rockefeller Center (begun 1932), and the new United States Customs Court and Federal Office Building Annex (1968) in New York.

Another limestone, the famous cream colored Caen stone from France, was introduced to New York State in the mid-19th century. It proved popular for interior carved decoration, but on exteriors it could not withstand the harsh climate. At St. Joseph's Church (1856-60) in Albany, Caen stone dressings had to be replaced with Indiana limestone in less than 20 years.

Sandstone

Like limestone, sandstone is a sedimentary rock. It is formed in layered beds of sand grains, usually particles of quartz, which vary in size and shape from course grit to microscopic, round grains. The major difference among sandstones is their cementing components, which affect their color and durability. The hardest sandstones, like New York State's Potsdam and Medina sandstones, are cemented with silica, which makes them as impermeable as granite. Sandstones are also cemented with varying amounts or combinations of iron oxides, which produce a reddish color, and clays, which produce a blue gray color. Sandstones are particularly sensitive to the freezing of water which has penetrated into the pores of the stone.

New York State sandstones are grouped into three categories -- Medina sandstone, Potsdam sandstone, and bluestone. The most important building stone in Rochester and Buffalo was Medina sandstone, which was quarried in nearby Orleans County throughout the 19th and early 20th centuries. Quarries located at Albion, Holley, Hulberton, and Medina, which were well situated near the Erie Canal and railroad lines, supplied both gray and red stone. The gray Medina sandstone was used in such buildings as the First Presbyterian Church (1871) in Rochester, but it lost popularity as a building stone by the 1890's, when the red variety took precedence.[5] Many major public buildings, including the monumental Buffalo State Hospital (1872-90), were constructed of red Medina sandstone.

Reddish brown in color and extremely durable, Potsdam sandstone was recognized in the 19th century as an almost ideal building stone.[6] Yet it was rarely used outside the western foothills of the Adirondacks, since the quarries were far from any city, and the stone was expensive to transport. Important exceptions include the Dominion Houses of Parliament (begun 1860) in Ottawa and the Cathedral of All Saints (1884-88, 1902-4) in Albany.

Bluestone belts are located along the Hudson River in Albany, Greene, and Ulster counties, along the Delaware River in Sullivan and Delaware counties, and in the Southern Tier, particularly in Broome, Tompkins and Wyoming counties. Unlike other sandstones, bluestone lies in thin beds. Because it has a somber blue gray color and cannot be extracted in large blocks, bluestone was rarely used for general building purposes[7]; notable exceptions include St. Peter's Church (1859) in Albany and Morrill Hall (1866-68) at Cornell University. On the other hand, bluestone was frequently used for sidewalks, sills, water tables, and other building trim.

Broome County Courthouse (1897-98) in Binghamton is constructed of Ohio sandstone, which became popular in New York State during the late 19th century.

Ironically, for a state rich in high quality, native sandstone, the most popular kind in the state during the mid-19th century was quarried in Connecticut. Soft and cheap, Connecticut brownstone was used beginning in 1840 to face blocks of rowhouses in New York City. Unfortunately, Connecticut brownstone was often face-bedded; because it was incorrectly laid, serious maintenance problems resulted (see p. 5).

Long after the demise of the Connecticut brownstone quarries in the late 19th century, better quality brownstone continued to be quarried from the same belt in Longmeadow, Massachusetts, and Little Falls, New Jersey. A fine, easily worked buff-gray sandstone from Berea, Ohio, first reached the western part of the state during the 1860's and subsequently became a building stone of major importance throughout New York State. Examples include the Ogdensburg Post Office (1867-70), the Powers Building (1870) in Rochester, and the Broome County Courthouse (1897-98) in Binghamton.

Granite

Granite, an igneous rock composed of quartz, mica, and feldspar, is generally considered the most durable type of building stone. It can be quarried in massive blocks and is favored for building plinths and water tables, because it is virtually impervious to water and therefore provides a natural barrier against rising damp from the ground. Granite does not, however, perform well in extreme temperatures, and it is the least fire resistant of all building stones. Because of its hardness, granite is the most expensive and usually the most difficult stone to quarry, finish, and carve.

Although a major consumer, New York State was never a major producer of granite. Granite deposits are located in only two regions of New York State -- the Adirondacks, and New York City and Westchester County. In colonial Manhattan, gneiss, a stratified type of granite, was quarried within the city limits and used in foundations and walls; a rare surviving example is St. Paul's Chapel (1764-66). Most New York State granite quarries were not developed until the late 19th century when the yellow-tinted Mohegan granite from Peekskill gained significant popularity after it was used in the Cathedral of St. John the Divine (begun 1892) in New York City.[8] Adirondack quarries also reached their peak production at the turn of the 20th century; much of the stone was shipped to Canada and the Midwest. An exception is the Picton Island granite used on the West 77th Street facade of the American Museum of Natural History (1889-1900) in New York City. In the eastern Adirondacks at Ausable Forks a dark grayish-green granite called anorthosite became popular during the early 20th century and is still quarried today.

Maine granite, first used in early 19th century storefront piers and lintels, monopolized the New York City granite market during the second half of the 19th century. Huge blocks of stones from coastal ledges of Dix Island, Mount Desert, Vinal Haven, Deer Island, and Hurricane

The Mile Square granite quarry, located near Yonkers, is still actively worked. It has supplied stone for hundreds of Westchester County buildings since the present owners opened the quarry in 1926.

Island were shipped by water at relatively low cost to New York. Maine granite was used in such monumental structures as the Metropolitan Museum of Art (1888), the New York City General Post Office (1914), and the George Washington Bridge (completed 1931). While granite from coastal Maine was coarsely textured, the inland quarries at Hallowell were celebrated for their fine, uniformly textured light gray stone, which was used in the New York State Capitol (1867-99) in Albany. Other popular granites were quarried at Westerly, Rhode Island; Stony Creek, Connecticut; and Milford, Massachusetts.

Cobblestone

Cobblestone, a form of construction that is virtually unique to central and western New York during the period between 1825 and the 1860's is an art that is quite separate from other masonry.[9] Cobblestones were not quarried but collected from fields, creek beds, and lake shores, sorted according to size, and set in horizontal courses with each stone projecting prominently from the mortar, which typically has thick, convex shaped joints.

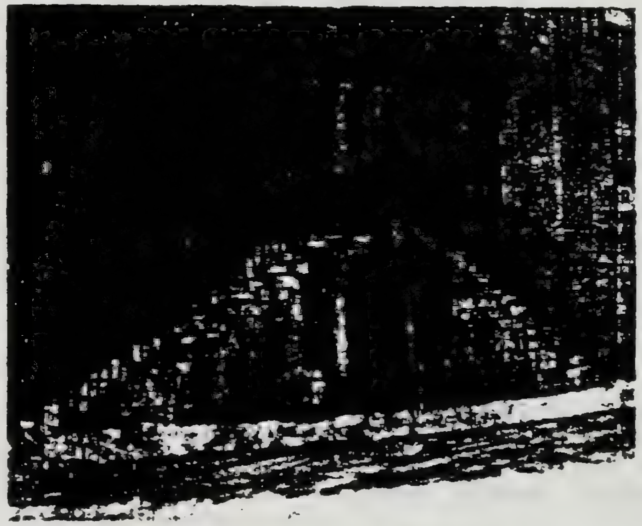
Causes of Stone Decay

It is essential to understand the forces of nature acting upon the building before any repairs are begun. Stone deterioration is closely related to the other parts and the other materials of a building, such as brick backup walls, mortar, iron clamps, gutters, cornices, and foundations and to the conditions surrounding the building, such as vegetation, poor drainage, and salts leaching through the soil. Consequently, the maintenance and ...uilding stone cannot be treated as an isolated

Stone deterioration originates with the exertion of some type of unusual pressure from either physical or chemical forces. Water penetration is almost always the source of the problem. Moderate exposure to rainwater is inevitable and, to some extent, beneficial. Damage occurs with cycles of heavy saturation and drying of stone, which are often caused by leaking gutters, ineffective cornices, blocked drains, or clinging vegetation. The most common causes of stone decay are described below.

1. **The freeze-thaw cycle.** Water drawn deep into the stone by capillary action causes mechanical stress on the pore walls during freezing. This is a major cause of stone deterioration in New York's harsh climate. Freezing and thawing affects limestone and sandstone more severely than granite and marble, which are relatively impervious.

2. **Salt crystalization.** Soluble salts are carried with water into the pore network where they form crystals. Because the salts have a larger volume when crystalized than when dissolved, their expansion damages the internal structure of the stone, and the salt deposits form efflorescence on the surface of the stone. Salts may be absorbed from the soil if the plinths or water tables are not constructed of an impervious stone. More frequently, salts originate in mortars containing Portland cement or from the brick or the backing material to which a stone facing is attached.[10] Efflorescence frequently appears on new stone facing placed against a damp backing material. Salts from bird droppings deposited on cornices and sills and sodium chloride scattered to melt ice on steps aggravate stone decay.



Commercial salt dumped on icy winter steps has a drastic, corrosive effect upon stone.

This sandstone gatepost has eroded because of crystallization and acidic action.

3. **Acidic action.** Acids deposited on calcareous stones, like limestone, marble, and some sandstones, gradually dissolve the stone. The result is roughening of the surface of the stone, separation of bedding planes where soft seams were washed away, erosion around harder fossil fragments, and loss of detail in carvings.[11] On sheltered surfaces not washed by the rain, hard, impermeable skins of calcium sulphate and sulpher dioxide from the atmosphere form on stone and can cause exfoliation, blistering and spalling due to differences in moisture and thermal movements between the skin and the stone.[12]

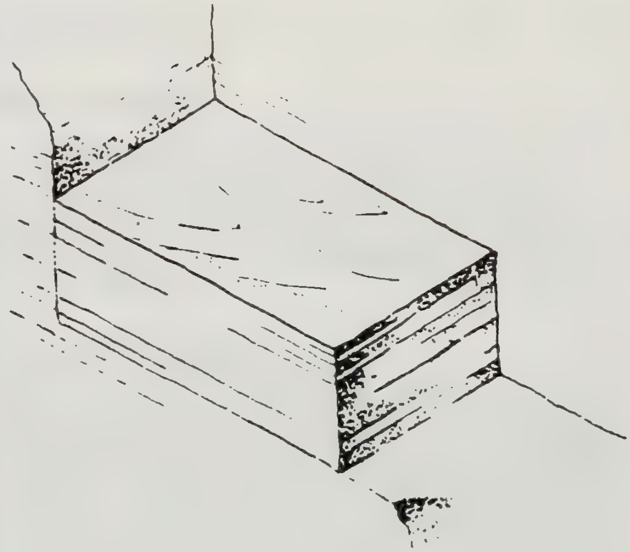
[illegible]tion. Moss, lichens, vines, and even thick shrubbery around a stone foundation tend to harbor moisture in stone by trapping it and preventing evaporation. Some plants also secrete acids which have a mild solvent effect, particularly on limestone and marble. But probably the greatest damage is caused by roots which gradually open joints and dislodge particles of mortar through mechanical action.[13]

5. **Structural settlement.** In cases of severe structural settlement, sound stones will crack at points of weakness, such as lintels and sills of doors and windows.

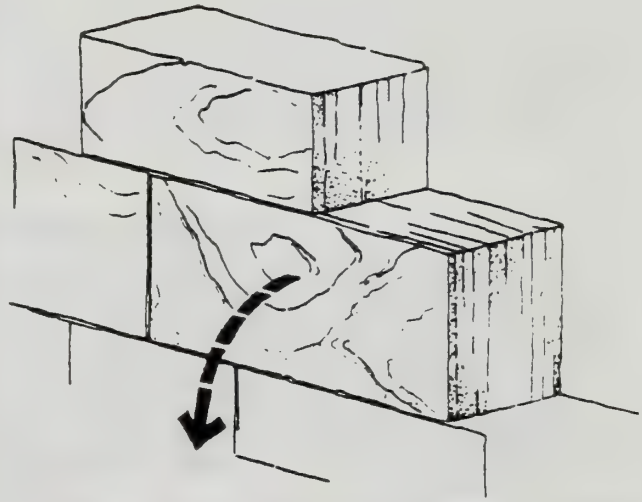
6. **Face bedding.** The durability of sedimentary stones, such as limestone and sandstone, can be drastically affected by the incorrect placement of the blocks in the building. Stone blocks should be laid in the same position as the stone originally lay in the quarry. On its natural bed the stone's bedding planes are horizontal. If face bedded, or laid with the bedding planes vertical and parallel to the face of the wall, the surface of the stone will scale in sheets or layers. Face bedding was quite common in 19th century construction; stone for columns or door jambs was often placed on end to take advantage of its greater length.

7. **Edge bedding.** Edge bedded stones are laid with the bedding planes vertical but perpendicular to the face of the wall. In time, the seams on the exposed surface of the stone may wash out between the laminations. Edge bedding is acceptable in cornices and string courses which would erode rapidly if the stone were laid on its natural bed.

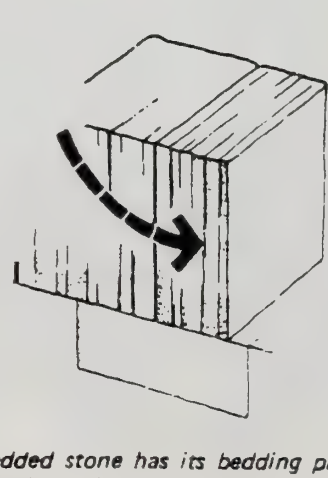
[illegible] joints. Spaces between stones that are inade[illegible] sealed with mortar allow water to penetrate deep into the masonry. Open joints are caused by settlement and by the failure of the mortar to withstand the physi-



The correct construction method is to place stone on its natural bed as it originally lay in the quarry.



A face-bedded stone scales in layers because it was placed on end with its bedding planes parallel to the face of the wall. Face bedding accounts for the poor condition of many mid-19th century brownstone buildings. (Arrow indicates scaling.)



An edge-bedded stone has its bedding planes perpendicular to the face of the wall. Seams on the exposed surface (indicated with the arrow) will wash out in time.

cal contraction and expansion of stone. This problem frequently arises because too little mortar was used or because the mortar has eroded because the mortar mix ... tain lime and was too hard (see section on mort... and pointing on page 7).

Rust expansion. Splitting caused by rusting of embedded ironwork is frequently a problem with railings set into stone steps as well as with concealed metal dowels and clamps inserted during construction, particularly in copings. As the iron corrodes, its volume increases, and it exerts too much pressure on the hole in which the iron member was fitted, thereby causing the stone to separate.

The embedded end of this iron railing has expanded as it rusted, cracking the corner of the sandstone step.

Cleaning Stone Buildings

A variety of cleaning techniques are available today; each has its advantages and disadvantages.[14] Decisions about the best method must be made on a case-by-case basis. In each instance the proposed method should be tested on different parts of the building during the preceding year in order to determine the most effective technique.[15] It may be necessary to use more than one cleaning method on buildings constructed of different kinds of stone or a combination of materials and in areas of delicate carving in the midst of massive stone surfaces. Cleaning is particularly important for urban buildings where streaky, uneven accumulations of salt and dirt not only are damaging but also may hide other problems such as settlement cracks, open joints, and deteriorated stonework.

Water Cleaning

In general, water cleaning is the most versatile, the simplest, and the cheapest method. Water cleaning involves a low pressure wash to soften the dirt deposits, followed by scrubbing with bristle brushes or a high pressure jet for stubborn, heavily soiled patches. The disadvantages of water cleaning are that the work must be completed in frost-free months and that prolonged spraying which saturates both the facing stone and its backing may pre... ...her problems such as dry rot, rust expansion, ... to interior plaster, woodwork, and paint. ...anning can usually overcome these problems. Another drawback to water cleaning is ginger-colored staining which often results on light marbles and limestones, although the stains usually fade in time or with subsequent washings.

Steam Cleaning

In recent years steam cleaning has decreased in popularity due to possible danger to the operator, expensive equipment, and limited effectiveness. It is still used for cleaning highly carved areas which would be damaged with brushing and for removing chewing gum from pavements and floors.

Chemical Cleaning

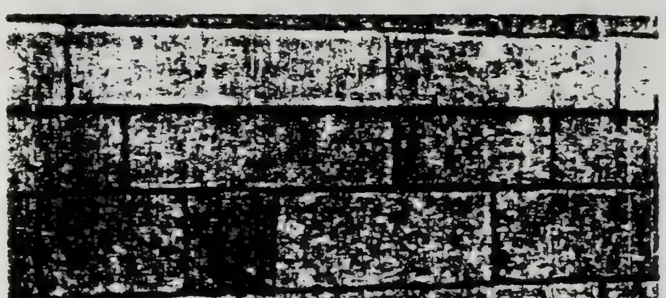
There are two general categories of chemical agents used in stone cleaning, acidic and alkaline. Their use demands a thorough understanding of the materials to be cleaned. Acidic cleaners are used on granite and some sandstones, but they will erode a limestone lintel or a glazed terra cotta ornament. Alkaline cleaners can be used on such acid sensitive stones as marble, limestone, and calcareous sandstone. To prevent harmful salt residues, chemical cleaners must be thoroughly washed off at the end of the cleaning process. Cleaning agents with significant amounts of hydrochloric acid (muriatic acid) or ammonium bifluoride are not recommended because of the risk of dangerous salt residues. The advantage of chemical cleaning over water is that faster results can be produced using smaller quantities of water with less risk of staining. On the other hand, rinsing off chemicals with water jets can force the cleaning agents into open cracks and joints.

Mechanical Cleaning

Sandblasting or abrasive cleaning with grinders and sanding discs is not recommended for cleaning stone. Relatively soft stones like limestone and marble cannot withstand this strenuous bombardment of abrasives and will become eroded and pockmarked. Polished stones will become dull and scarred. Mineral grains of even hard granites can be shattered or pulverized by sandblasting, leaving the building without its original sparkle and luster.[16]

Maintenance of Cleaned Surfaces

Once properly cleaned, a building should ideally be given regular, light washings (at five year intervals in urban areas) to prevent subsequent serious build-up of dirt.[17] Waterproof coatings and silicone water repellants have not proved effective in dirt inhibition or in stabilization of stone decay. Instead, they may seriously damage masonry by trapping water behind the coating.



Sandblasting has left this stone water table badly pitted and scarred.

Stone Repair

Choosing the best method of stone repair will depend upon the condition of the masonry as well as the method [illegible]ction. For most repairs,[18] the choice will be [illegible] stone or a plastic repair, the process of reconstructing decayed stone with a mortar of cement and crushed stone or sand. But very often the best solution may be to leave the stone alone. Many well intentioned efforts have caused irreparable damage that outweighs the harm caused by natural deterioration.

Ideally, replacement stone should be obtained from the original quarry or quarry region. If stone from the original quarry is no longer available, stone from another quarry may provide a good match.[19] The chart on pages 8 and 9 lists quarries that are still in operation. With stones that are difficult to match, such as Onondaga limestone, it may be necessary to reuse old stones that have been either salvaged from another structure or removed from an inconspicuous part of the same building. Alterations, such as new openings, may provide surplus stone. Unfortunately some soft stones, particularly friable brownstone, will shatter under modern saws. New stone must match the original color and texture of the old stone; even if the building cannot be cleaned when the repair is made, the choice of replacement stone must be suitable for that eventuality.

Duplicating the original tooling, or chisel marks, may present another repair problem. Many different hand-tooled finishes were used during the 19th century on lintels, foundations, and walls. Because the tooling is important to the overall character of the building, it should be reproduced accurately. Some old finishes cannot be duplicated using modern power equipment and must be tooled by hand.[20]

[illegible]tep in a plastic repair is to cut back all the loose and decayed stone to a sound surface by hand, using a hammer and chisel. The area is then rebuilt through the application of layers of mortar made from cement and crushed stone or sand. One advantage of plastic repair is that it disturbs little of the adjacent stonework. It is a useful method for sections of moldings which would be difficult to replace with new stone. A plastic repair undertaken by a specialist can be almost invisible. In less successful cases, the color or texture of the new material may not match the original stone, the patch may not adhere properly, or the stone may continue to decay behind the patch.

Preservatives that consolidate weathered stone have proved feasible for sculpture that can be submerged in the solution. However, wall surfaces can be treated from only one side, and preservatives for walls are still in the experimental stage.

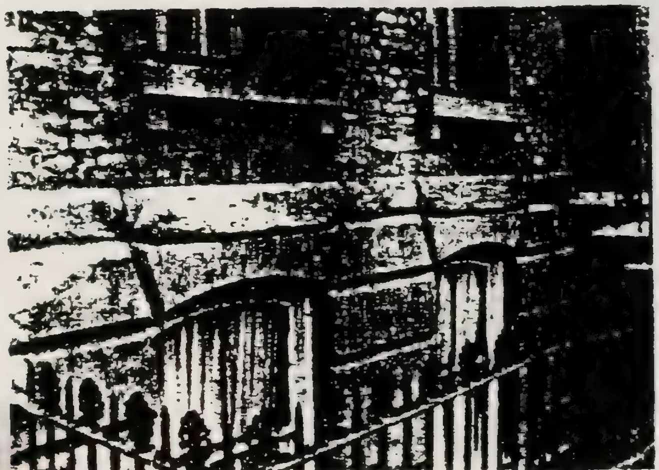
In extreme cases of general surface decay, the best solution may be to scale back much of the existing stonework. The loose, scaling portions are broken off with chisels and hammers, and the new surface is dressed again.

Mortar Joints and Pointing

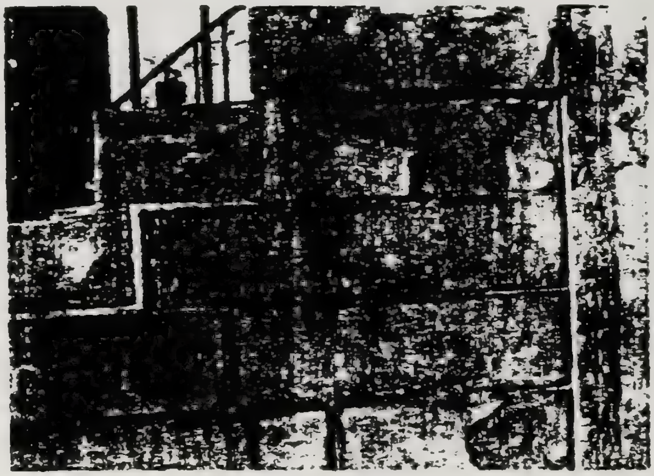
The entire character of a building, as well as its physical condition, can be drastically affected by what might seem but a detail -- the mortar between the stones. Repointing, the process of scraping or raking out the exposed, deteriorated mortar by hand and replacing it with fresh mortar, is one of the most frequent repairs to a stone building.[21] Because hard mortars trap moisture and form rigid joints which cannot compensate for building movement, incorrect pointing can lead to a new cycle of deterioration that may include open joints, efflorescence, spalling, and even splitting of the stone.

New mortar should match the original in strength, hardness, profile, and color. Like other trades, pointing has changed over the years, particularly around 1880, when Portland cement, still in use today, became popular in the United States. Before that time mortars contained lime or natural cement, a form of hydraulic lime manufactured in several parts of New York State. These "soft" mortars provided a relatively elastic cushion between the stones, and for that reason, the joints should not be repointed with Portland cement.

The profile of the existing mortar joint should be studied before it is raked out as a guide to its replacement. Although a concave mortar joint is considered the most weathertight, the mortar may have been trowelled flush with the masonry surface, recessed in a variety of ways, or raised. Some early joints may be so thin that no mortar is visible at all, while late 19th century ribbon pointing protrudes from the stone surface conspicuously. Early 19th century mortars were usually light in color; darker mortars became popular later in the century.[22]



[illegible]ved portions of this brownstone water table [illegible]en chiseled out, in preparation for plastic repair. The sills and basement, which had also deteriorated badly, have already been repaired.



New mortar joints should match the originals in strength, hardness, profile, and color. No attempt was made with the thick, uneven concrete joints between these bluestone steps. Note also the scaling stone.

Sources of Stone for Restoration and Repair

Marble

Name of stone	Where to find it today			Comments
Vermont marble (Danby, Dorset, Rutland, also Champlain black, verde antique)	quarried by:	Peter Navari Vermont Marble Co. Proctor, Vt. 05765 802-459-3311	Stanley Gawet Gawet Marble and Granite Co. Center Rutland, Vt. 05736 802-773-8868	most stone used in the 19th century is still available
Lee (Mass.) marble	quarried by:	Lee Marble, Inc. Marble St. Lee, Mass. 02138 413-243-3210		old quarry reopened summer, 1977
Tennessee and Georgia marble	quarried by:	Georgia Marble Co. 2575 Cumberland Parkway, N.W. Atlanta, Ga. 30339 404-432-0131		
Alabama marble	quarried by:	Moretti-Harrah Marble Co. P.O. Box 330 Sylacauga, Ala. 35150 205-235-5261		

Limestone

Name of stone	Where to find it today			Comments
Indiana limestone	three of the major quarries are:	B. G. Hoadley Quarries P.O. Box 1224 Bloomington, Ind. 47401 812-332-1447 Indiana Limestone Co., Inc. 405 I St. P.O. Box 72 Bedford, Ind. 47421 812-275-3341	Terry and John Edgeworth Victor Oolitic Stone Co. P.O. Box 668 Bloomington, Ind. 47401 812-824-2621	further information available from: Indiana Limestone Institute of America, Inc. Suite 400 Stone City Bank Bldg. Bedford, Ind. 47421
Queenston (Canada) limestone	quarried by:	J. D. Lauder Queenston Quarries P.O. Box 387 Niagara Falls, Ontario L2E 6T8 416-262-4279		durable gray stone used in western New York primarily for sills and steps
Miami Valley (Ohio) limestone	quarried by:	Gregory Stone Co., Inc. 1860 N. Gettysburg Ave. Dayton, Ohio 45427 513-275-7455	J. O. Kamm Cleveland Quarries Co. Amherst, Ohio 49001 216-986-4501	
Alabama gray veined limestone	quarried by:	R. B. Dill Alabama Limestone, Inc. Rt. 3, Box 95 Russellville, Ala. 35653 205-332-3700		

Sandstone

Name of stone	Where to find it today			Comments
Alcove (N.Y.) bluestone	available from:	Adam Ross Cut Stone Co. 1003 Broadway Albany, N. Y. 12204 518-463-6674		dry wall stone
Elkbrook (N.Y.) bluestone	quarried by:	Alfred Johnston Johnston and Rhodes Bluestone Co. East Branch, N. Y. 13756 607-363-2282		
Lenroc (N.Y.) bluestone	quarried by:	Brud Dolph Finger Lakes Stone Co., Inc. 382 The Parkway Ithaca, N. Y. 14850 607-273-4646		
Malone (N.Y.) quartzite	quarried by:	Janet Basilieri Northern Adirondack Quarries, Inc. 86 Catherine St. Malone, N. Y. 12953 518-483-4769		buff, mauve colors; used locally for restoration
North River (N.Y.)	quarried by:	Paul Gebitz Heldeberg Bluestone and Marble, Inc. East Berne, N. Y. 12059 518-872-0242		